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DRAFTING OFFICE PHOTOGRAPHY.

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It is not likely that the process of copying drawings by photography will ever become so universal as is the present system of tracing by hand, but there are enough good points about it to warrant a description. The process consists in photographing the drawing on to a glass plate by means of a camera, from which plate prints may be made—blue, brown or black, as you please, but with dark lines on a light ground instead of the unnatural and often confusing light lines on a dark ground.

The system has its limitations. Plates of large size are expensive; they are fragile and are difficult to handle, but these very restrictions may prove to be advantageous since they will lead to a uniformity of size, and a handy size at that. Talk about a man "getting onto his job," haven't you seen drawings so large that when they are spread out the workman will literally need to climb onto and over them?

A camera for copying drawings is shown in Fig. 1, suspended from the ceiling to avoid the vibrations of the building due to the motion of machinery or the slamming of doors.

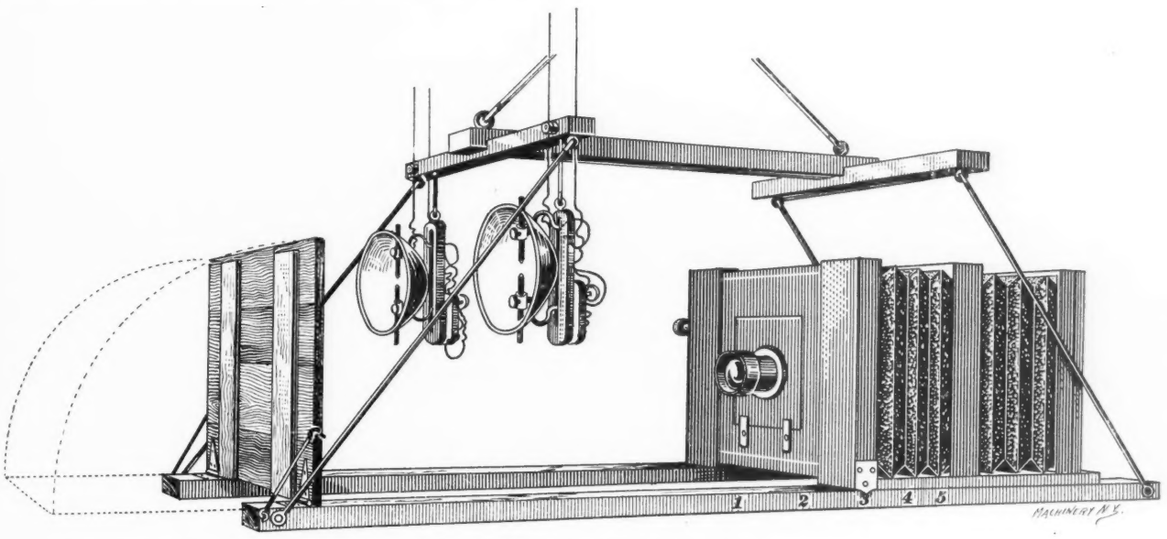


Fig. 1. Camera for Copying Drawings.

An arrangement of electric arc lights is also shown, for this work can be done either by night or day. The lens is the most important part of the outfit and must be capable of copying straight lines without the least diffusion or aberration. Rule a sheet of paper into squares and test the lens by seeing if all these squares appear true on the ground glass. If they are distorted, as in Fig. 3, the lens is unsuited for this business, although it may still be a very good lens for landscape or view work.

The usual photographic dry plates are too "soft" for copying drawings; we need plates which will yield very dense black negatives with the thin parts as transparent as clear glass. Photo-engravers use such plates in their work, but they employ mainly the "wet-process," coating their own plates just before using—a trick which we have neither the skill nor the appliances to do successfully. "Process" plates suitable for this work can be had from almost any dealer for about $3.80 per dozen for the 10 x 12 size, and a drawing of 25 x 30 inches may be reduced to 10 x 12 inches with all of the lines clear and all of the figures legible. Directions for compounding the chemicals accompany every box of plates and will not be referred to here for fear of making this article too technical. Process plates dry very quickly. Unlike the usual dry plates, the gelatine coating will not melt with heat, so that a negative may be exposed, developed, fixed, intensified, washed and dried and made ready for printing in an hour, while a tracing of the same thing might take days.

These plates are comparatively slow; in making a full-sized copy under a fair light with the lens stopped down to f 32, an exposure of about one minute will be required. Less time must be given if the copy is much reduced since all the light from a large drawing will then be concentrated on to a small plate.

The accompanying diagram, Fig. 4, will show the relative distance from the copy to the lens and from the lens to the ground glass for different degrees of enlargement or reduction, f being the focus in inches.

The possibility of changing the scale of the drawing and of making the copy larger or smaller than the original is one of the most valuable features of the process. Shrunk plans may be enlarged to their original size, or, since most blue prints shrink after washing, the negative may be made with this shrink added in copying, so that the print will be exactly to scale.

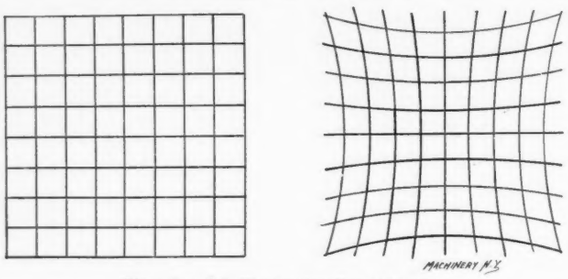
In the same manner working drawings of parts of machinery may be photographed for the pattern maker and the proper shrink for iron or brass may be added in copying so that the print will be of the exact size of the pattern. This is particularly advantageous in case of complicated core work because sometimes a man will get confused and allow for shrink the wrong way. In export trade with countries using the metric system it is often desirable to furnish plans to a metric scale, which is not much used in this country and, owing to our unfamiliarity with this system, it is usually a matter of some difficulty and expense for a draftsman to translate a drawing from one system to the other. If the plans on hand are now drawn to a scale of 1 inch to a foot, or 1-12 size, it is an easy matter with the camera to copy them 1-10 size or 1-20 size or to any metric scale desired. Where dimensions are given in feet and inches they should also be re-figured in meters and millimeters so as to read in both systems.

Photographs can be taken from almost any kind of a "faked

up" copy. Hand-made drawings, reading matter, catalogue cuts and photographs can all be pasted together on a card and photographed into one harmonious whole with no visible sign of a joint or seam.

A little difficulty may be experienced in copying blue prints owing to the fact that blue is the most actinic color. Blue "takes light" and there is little contrast between it and white. This difficulty may be overcome by saturating a swab of cotton with ammonia and holding it near the blue print. The fumes of the ammonia will cause the print to turn dark purple which will photograph well, that is to say, it will not photograph at all, but will permit the white lines to appear with good contrast.

I recall one instance where some blue prints and specifications were sent us with the request that we prepare plans and submit bids for weighing machinery to go into the



Figs. 2 and 3, Illustrating Test of Lens.

positions indicated. It was intimated that the first bidder to submit plans would probably get the contract. We did not stop to make any original drawings, but took their blue prints and drew in on them our scale work, using Chinese white. We then photographed them in the manner just described and from this negative we were able to get out blue prints even better than the originals, and better still, to submit them by return mail and get the job.

Almost any kind of printing paper may be used. The familiar blue print paper if of good quality yields dark blue lines on a white ground. "Maduro" paper (Keuffel & Esser, N. Y.) gives dark brown lines on a white ground. It prints a little quicker than blue, is a little more expensive and requires a little more work since it needs to be fixed in a special bath, the chemicals for which come with each roll of paper. This paper gives such excellent results as to warrant all these extra items. The best paper, however, for copying line

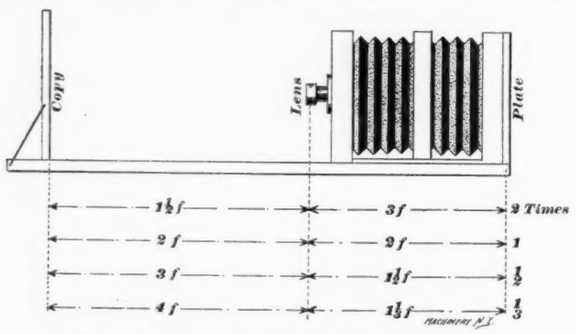


Fig. 4. Ratio of Distances for Various Enlargements.

drawings is "Velox," to be had of all photo dealers. This gives jet black lines on a pure white ground and resembles a pen drawing even to the slight gloss of the ink, so closely in fact that a photo engraving may be made from a Velox print. This is a great advantage in doing business with a certain class of "high-toned" customers, since at a slight expense a plan may be furnished them which has the appearance of being an original hand-made drawing, gotten up for their exclusive trade. This paper is so sensitive that it will print in a few seconds by daylight yet not so sensitive but what it may be handled and developed in some dim corner of almost any room.

I mentioned the possibility of drying a process plate by heat, but by using Velox paper the negative need not be dried at all, but may be printed from while wet. Soak the paper for an instant to allow it to expand before placing it in contact with the film, taking care to rub out all air bubbles, then proceed as usual with the exposure and development. Many firms do a large variety of special work which they do not care to list in their regular catalogue and yet which they would like to show up to their intending customers. In such cases an attractive supplementary catalogue may be gotten out by printing photographs of such machines on Velox paper, using sheets about an inch larger than the negative so as to allow a margin all around the print. Prints of this character are far superior to half-tone engravings and for a limited edition, very much cheaper.

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A SUMMER SCHOOL OF ENGINEERING.

The University of Wisconsin has made a departure in the matter of technical instruction that will meet with the approval of many who feel that they cannot become students in the regular engineering courses. A summer school has been organized for apprentices and artisans, and for young men who wish to qualify themselves in the various mechanical trades. In the case of apprentices, the purpose of the school is to give them a certain amount of theoretical and practical instruction in the line of their trade that they would not get in the shops, but it is not the purpose of the school to give the shop practice which they are expected to receive in serving their apprenticeship.

The practical abandonment of the apprenticeship system, and the adoption of labor-saving machinery in many shops, leaves these young men with no means of acquiring the knowledge that they ought to have to become proficient machinists. The instruction is to be given during a term of six weeks, the tuition for which is $15. No specific educational requirements are named as the conditions for admission, but each candidate will be questioned, to ascertain his fitness for taking up the work. A speaking and writing knowledge of the English language, and a fair knowledge of elementary arithmetic, will be found necessary. It is believed that many employers would be very willing to give leave of absence to enable their employes to take advantage of this course. It is also thought that the regular students of the engineering course at the university will be able to perform most, if not all, of the requirements in shop practice during the summer by taking advantage of this course, and thus have more time during the school year for other subjects.

The courses of instruction include steam engineering, applied electricity, machine design, materials of construction and transmission of power, and shop work.

It is our opinion that this step on the part of the officials of the University of Wisconsin will be of the greatest value to many promising young men lacking the opportunities of some of the more fortunate ones who can take the regular course.

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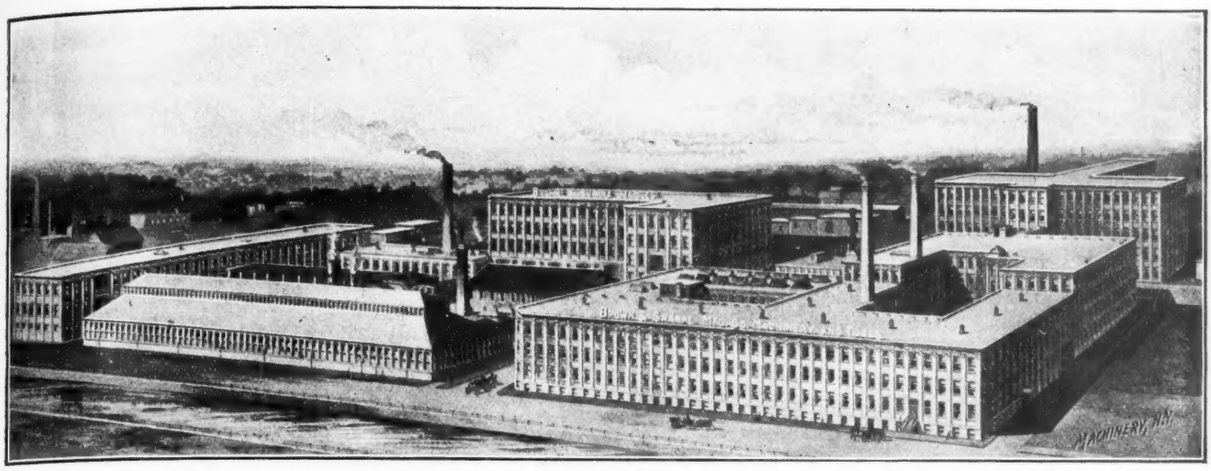
The March issue of STEAM ENGINEERING is an interesting and valuable number for the practical engineer. The second instalment of "Power and Heat for Office Buildings," by Chas. L. Hubbard, treats of the various forms of grates, smoke prevention and the various fuels. The progress of smoke prevention under the direction of Prof. C. H. Benjamin is noted and recent appointments to the working force. There are four educational articles taking up repairs to engines, pumping machinery, electricity, and strength of boilers. The first, by Chas. J. Mason, gives practical directions for making such repairs as are likely to be needed on Corliss engines, pumps, etc. The second article, by Geo. L. Fowler, on "Pumps and Pumping Machinery," is the eighth instalment of a valuable series. The third, by Prof. Tell (the nom-de-plume of a well-known writer on electrical subjects), explains the principles upon which ammeters, voltmeters and wattmeters operate. Half-tone engravings are given of the boilers and parts of the large crankshafts of the steamers Siberia and Korea, now building at the works of the Newport News Shipbuilding & Drydock Company. These vessels are the largest steamers ever built in the United States. The letters from correspondents and the answers to queries as usual form two of the strong features of the journal and are alone well worth the subscription price.



THE BROWN & SHARPE MFG. CO.'S WORKS.—1.

DESCRIPTION OF THE BUILDINGS AND VIEWS OF SEVERAL DEPARTMENTS.

IF one were planning a tour of inspection of American shops, the works of the Brown & Sharpe Mfg. Co., Providence, R. I., would be among the first to be included in the list of those to be visited. This is not entirely because of their magnitude, nor because of the striking things to be seen there, although upward of 2,000 men are employed, and the equipment of tools and appliances is remarkable in extent and variety. It is due, in part, to the knowledge among those engaged in shopwork that the methods and equipment of this company are representative of the best practice of the day and that the reputation of their products for accuracy, finish and reliability has been obtained through actual use in the shops of the world, rather than through pretentious claims.

There are several thousand readers of MACHINERY, however, who may not have the opportunity of visiting these works. For their benefit, and to recall the works to those who have seen them, we shall publish in this and other numbers of the paper something about the plant and the methods in vogue there, and we shall illustrate some of the things that would be seen by a visiting mechanic. It can be added, moreover, that any who may find it convenient to visit the works of the Brown & Sharpe Mfg. Co. will be accorded a welcome and will be shown many features of interest in the various buildings and departments.

The original business from which the present organization has grown was started in 1833 by David Brown and his son, Joseph R. Brown. Later it was conducted by the son alone, until 1853, when he formed a partnership with Lucian Sharpe. The firm name was then J. R. Brown & Sharpe, and it was not until 1868 that the name became the Brown & Sharpe Mfg. Co. During the early life of the concern the buildings occupied had never been well adapted to the business, and in 1872 it was decided to erect a building on the present location of the works.

As is often the case, the machines and tools now manufactured are largely the outcome of the needs felt in their own manufacturing, and were first made to assist in the production of their regular work. Thus, in 1859, the manufacture of the Wilcox & Gibbs sewing machine was commenced, and milling and grinding machines were designed and built to facilitate its manufacture. The original universal milling machine was built in 1862, and the first successful universal grinding machine was patented in 1877. The well-known type of milling cutter, which can be ground without changing its form, was also the outgrowth of the needs of sewing machine manufacture, and was patented in 1864 and employed for cutting gear teeth. The manufacture of steel rules was commenced in 1850, when the first graduating machine for this purpose was made. At the present time the machines regularly manufactured number over 70, and the small tools for machinists' use over 300. Over 2,000 men are employed, as stated above, and the buildings have a floor space of over eight acres.

Referring to the general view of the works, the original building, erected in 1872, appears at the right-hand front corner of the group. This, with the extensive additions that have been made to it from time to time, comprises nearly a whole block, 225 by 295 feet, and is used as the main building, in which are located the general offices and some of the largest and most important machine departments. On the first floor is the milling machine department, where some of the heavier work is done; on the second, the department where the milling cutters, gear-cutting machines and grinders are made; on the third, the sewing machine department; and, on the fourth, the tool-making department.

The largest addition to this building is the extension at the rear, erected in 1894, which rises one story higher than the earlier portions of the building. In 1900 a central wing was added, which can be detected at the left in the general view by the "sawtooth" windows in the roof. The upper floor of this wing was laid out and equipped for a drafting room, which is one of the most carefully planned, convenient and attractive drawing rooms to be found in the country.

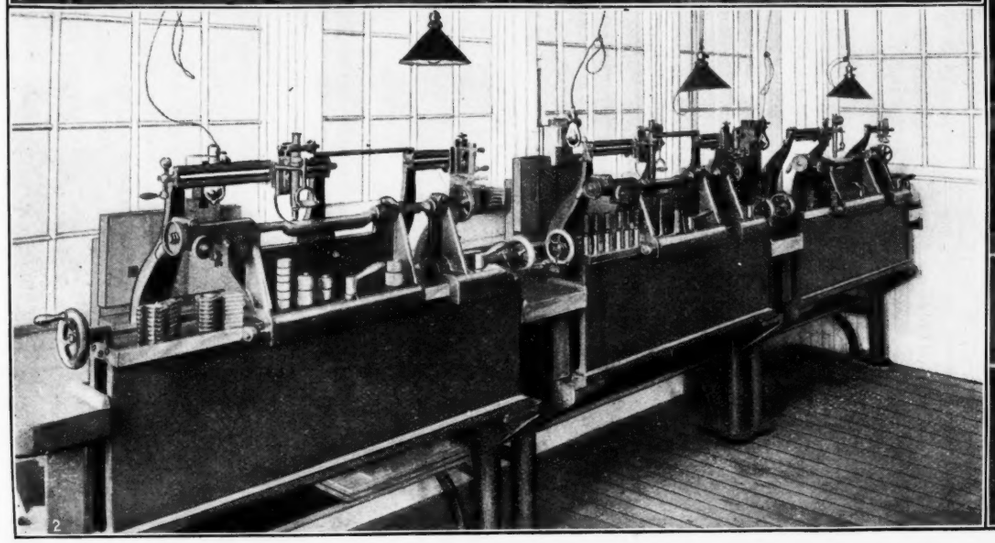
Drafting Room and Departments of the Main Building.

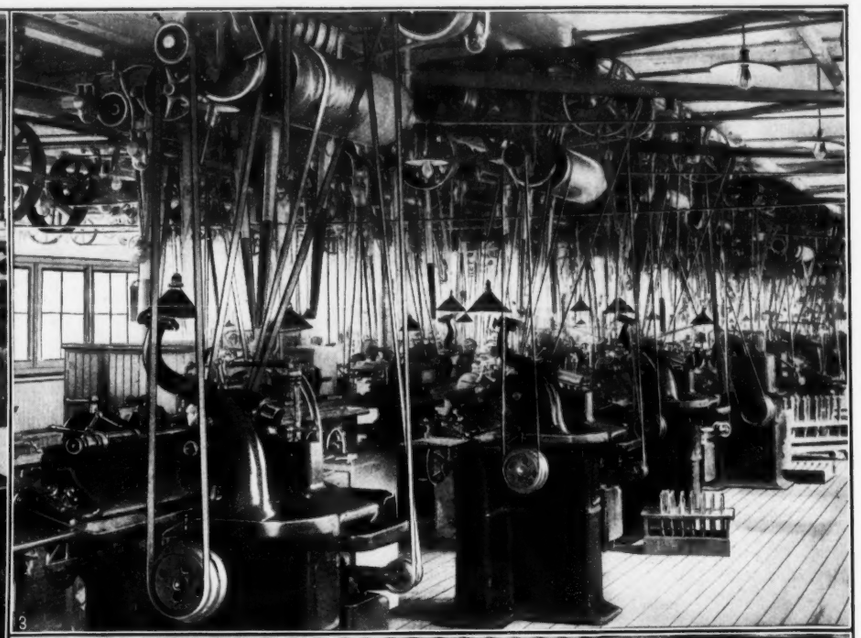
The location for the drafting room was selected with a view to its being easily accessible to as many of the departments in the various shop buildings as possible, which facilitates interchange between the foremen and draftsmen when explanations are needed or there are practical points to be discussed. A passenger elevator connects the drafting-room floor with the other floors of the building. This is not intended "for visitors only," but is in constant use by draftsmen, workmen and others whose duties cause them to pass to and from the drafting room. It is found that a passenger elevator for such use is as much appreciated here, and is as much needed as a source of true economy, as in other locations where it is much oftener found.

A general view of the interior of the drafting room is shown in Fig. 1 of the first group of views. As the part of the building in which the room is located was built and equipped expressly for the use of the designing and engineering departments, there was every opportunity to meet the various requirements of these branches.

First of all is required good light, and this is secured by the windows on three sides and by 14 skylights, each of which is placed directly under a cover or roof of "sawtooth" pattern, having corrugated glass windows facing nearly north. All the windows have two roller shades, both on brackets at the centers of the windows, so that one shade can be pulled up to cover the upper sash and one pulled down to cover the lower sash. Each desk is also provided with incandescent lights, suspended from the ceiling by universally adjustable lamp brackets, which can be removed in the summer time, giving clear overhead room.

The next consideration, perhaps of equal importance, is





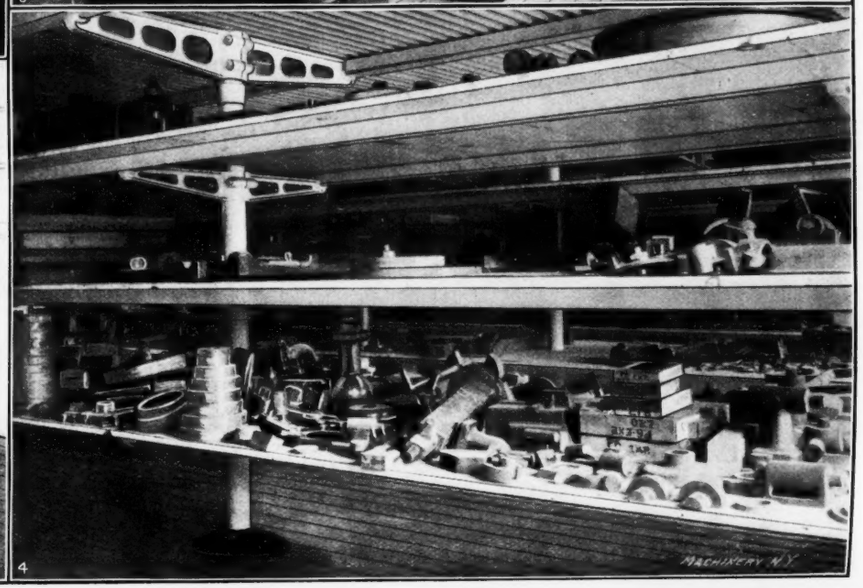


Fig. 1. View of drafting room from near chief draftsman's desk. Stairs at the left lead to blue-print room. There are desks for forty men and all have good light.

Fig 2. Group of three measuring machines. These are graduated to read to .00001 inch and will measure a piece sixteen inches long.

Fig. 3. Grinding department in basement of main building showing group of No. 11 plain grinding machines. There are about fifty universal plain grinding machines in this department.

Fig. 4. Pattern storage. Construction as nearly fireproof as possible. Shelves supported by iron frames and the upper shelves are made accessible by an intermediate floor of corrugated iron between the main floors of the building.

the heating and ventilation. Both are effective, and give a pure atmosphere of uniform temperature. There are steam coils under each window, and hot air is also forced in at the top of the room, with ventilation ducts near the bottom. To allow windows to be raised without causing a draft, or inflicting colds or scattering papers, a hinged glass protector or partition has been attached at the base of each window frame. These do not appear in the illustration.

The drawing tables are three by eight feet, and three by fifteen feet, the latter arranged for two men to work at the same table. The general features of construction of the tables are evident from the illustration. The drawing boards all have parallel rulers in place of T-squares.

Adjoining the drafting room are six offices, separated by glass partitions, for the use of the mechanical engineers and designers, or specialists, where they are easily accessible for consultation.

Very complete blueprint and photographic rooms have also been fitted up in connection with the drafting room. The stairs at the left in the interior lead to the blueprint room, which is one story higher than the rest of the building. The photographic room opens from the drafting room, and is properly lighted for photographing machines, which are brought directly to the room from the floors below by a freight elevator. Blueprinting frames of somewhat novel construction are in use, and their main features will be described in a future issue.

Another interesting view in the main, or "No. 1," building, is that of the grinding room shown in Fig. 3 of the first group. This department is in the basement, and most of the small tools and parts of all machines are brought here at some stage in their manufacture. Near this department is the polishing and buffing room, which, while not so interesting a place, has the feature of cleanliness that is seldom found where polishing is done. The polishing wheels are connected with exhaust fans, and the absence of the usual dust is very noticeable, even the windows having a clean appearance. Still another department in this basement worthy of mention is the washroom, with accommodations for 550 men. Each is divided into three longitudinal sections, the middle one containing clean water for rinsing the hands and washing the face, the outer compartments serving a more severe duty. Similar washrooms are located in other parts of the works, and there are bathrooms connected with the foundry.

The Foundry.

Directly at the left of the main building, in the general view of the works, is the foundry, a large, one-story structure, with monitor roof, built in 1880. It is 266 feet long, and its most noticeable feature is the large amount of wall space occupied by windows, which, with white walls to reflect the light, make a room that is unusual for foundry purposes. There are two cupolas; one being used for the regular work, and the other for special mixtures, when required.

Adjoining the foundry are the rattlers, pickling beds, annealing furnaces, core ovens and shipping rooms. The shipping room is enclosed and castings can be sorted and loaded without exposure to the weather. The rattlers, core ovens and annealing furnaces are of the regular Brown & Sharpe pattern, the feature of the core ovens being that the cores are baked by the radiation of heat from cast iron passages, through which the heated gases pass, without the cores coming in contact with the smoke and gases from the fire. The pickling bed consists of a wooden inclined plane, on which the castings are placed. This is arranged to drain either into a tank containing the acid or into the sewer. A good proportion of the acid is thus saved, and after the pickling process is completed the castings can be washed with the hose while they are still in place on the pickling bed, the water running into the sewer. A 50 per cent solution of sulphuric acid is used for pickling. All the small castings are annealed by being brought to a red heat in the annealing furnace, where they are allowed to remain over night.

No. 3 Building.

The large building at the left of the foundry, in the general view, is known as the No. 3 building, built in 1891 and 1893, in which are the pattern storage and carpenter shops and the department in which the calipers and other small machinists' tools are made. A view of the pattern storage is given in Fig. 4 of the first group of views. This is made as nearly fireproof as possible, the floors being supported by steel beams with brick arches between the beams, the construction that is used in all the buildings. In the pattern storage room the floor columns are covered with non-conducting material, and the framework of the shelving holding the patterns is of metal. The columns of this framework are of 3 inch wrought iron pipe, and the cast iron brackets are fastened to them by clamping opposite brackets together against the column. The front edges of the shelves are supported by angle irons attached to the outer ends of the brackets, and running parallel with the shelves. As the space between the floors is so great that the upper shelves would not be easily accessible, an intermediate floor of corrugated iron is employed, which appears in the upper part of the illustration.

Measuring Machines.

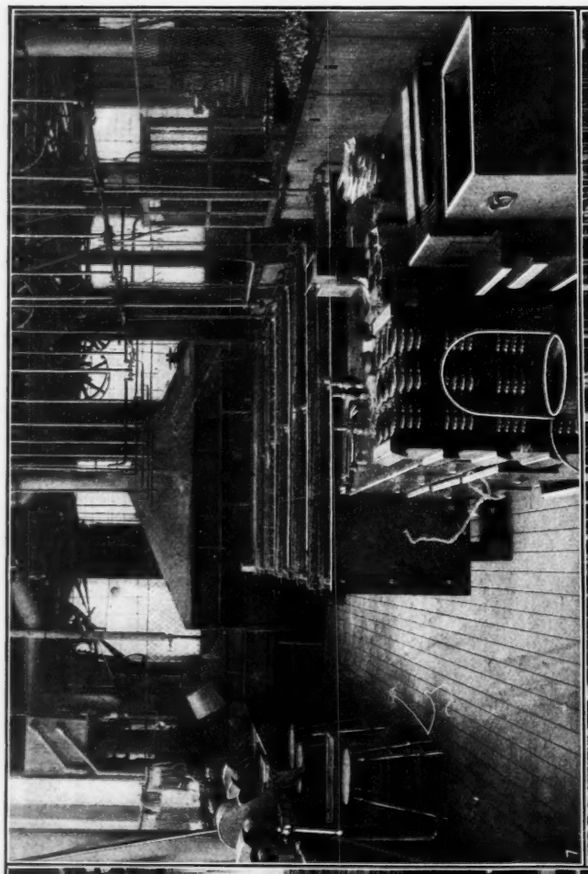
One of the most interesting features of the No. 3 building is the room containing the measuring machines. Three of these machines appear in Fig. 2 of the first group. Each machine has a very deep bed to resist the tendency to deflect when the anvils or measuring points are brought in contact with a piece to be measured. The carriage at the left of the machine supports a bar, the ends of which are cylindrical, but one-half the central portion of which is cut away, leaving a flat surface passing through the axis of the bar. An 8 inch scale, graduated with the greatest accuracy, is attached to this flat surface, and as the scale thus lies in the neutral axis of the bar its length is not materially affected by the deflection of the latter. The graduations on this scale are so minute as to be invisible to the naked eye, except under favorable conditions of light. At the right of the machine is a carriage carrying a micrometer head. The dividing wheel of the micrometer reads to .0001, and a vernier in connection with this wheel reduces the readings to .00001th of an inch. One of the measuring anvils is attached to the bar on which the scale is fastened, and the other is on the end of the micrometer screw. The bar containing the scale can be moved longitudinally in its carriage, and in measuring a piece the bar and its measuring point are brought to a position where both anvils almost touch the piece to be measured. The measuring point connected with the micrometer is then brought into contact with the piece. The main dependence is placed upon the divisions of the scale, rather than upon the micrometer screw, the latter being used only for measuring very short distances where the total error would be imperceptible.

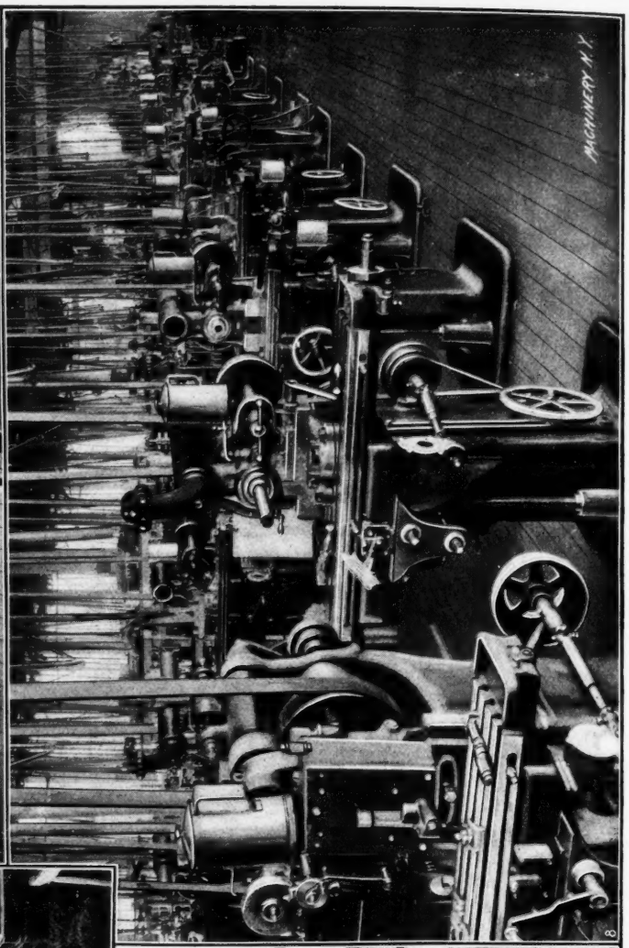
Both the divisions on the scale and on the micrometer wheel are read, and the former located by the aid of the microscopes. These microscopes can be moved on slides parallel with the ways of the machine, and it is by this means that the adjustments of the machine are made. Thus, to locate the measuring point of the bar at a certain distance from the other point, the two anvils are brought into contact and the reading noted, and the bar is then moved back until the reading of the microscope shows that it has moved the required distance. By shifting alternately the bar and the microscope, the machine can be set to measure distances up to 16 inches.

Directly back of the main building is the newest addition to the plant, consisting of a five-story structure, the main section of which is 178 by 50 feet, with a wing 113 by 50 feet. The window space in this building is 25 to 30 per cent greater than in any of the other buildings. This addition is just completed and will shortly be occupied, relieving several departments of the works that are now badly crowded.

Details of the Brown & Sharpe Type of Building.

The general type of building adopted by Brown & Sharpe is that resembling, on the outside, the mill style of archi-





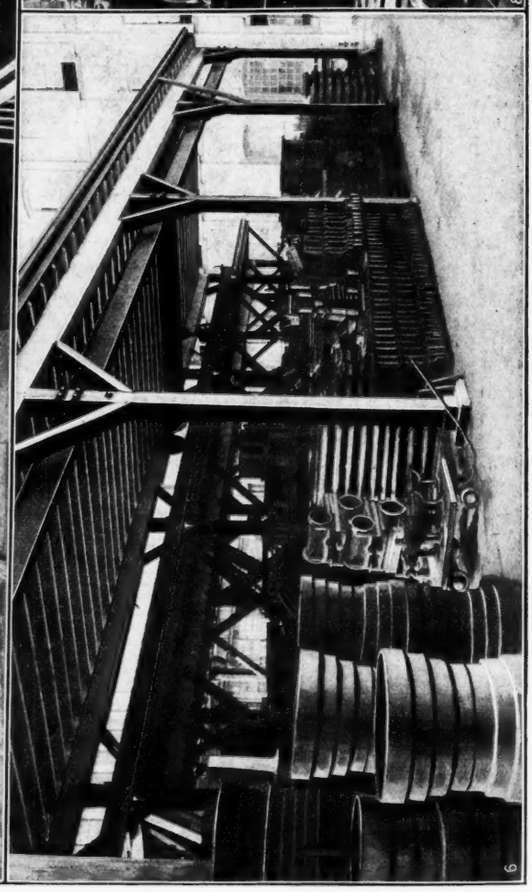


Fig. 7. Nickel plating room. The plating baths are shown in the middle of the room; the washing sink at the left. The polishing wheels at the *left*.

Fig. 8. Machine department. Floor "C," No. 2 building. The first machine at the left is provided with a slotting attachment.

Fig. 5. Interior of foundry, which is 396 feet long. The wall space is taken almost entirely by windows. The passageways are paved with metal plates.

Fig. 6. Foundry yard. The castings were not arranged for photographing, and the illustration shows the usual appearance.

tecture, with several floors, brick walls, large window space and with pilasters running from basement to roof between the windows. The pilasters have two flues each, used for ventilation and heating by forcing hot air through them and through registers opening into the different rooms. The floors are supported by steel beams, filled in between with brick arches, with rows of supporting columns running through the center of the building. The floor covering is

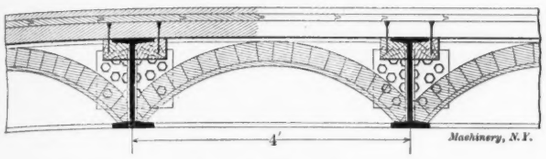


Fig. 1. Floor Details.

of three layers, the first being spruce plank, the next spruce boards laid diagonally with the plank, and the top layer hard pine or maple. The two bottom sections are tongued and grooved, but the top is not, to facilitate making repairs. The basement floors are upon a foundation of concrete 12 inches thick, consisting of 1 part Portland cement, 4 to 4½ parts of sand, and 8 parts of crushed stone. This is covered with coatings of hot pitch and of tar concrete, and the floor planks are spiked to chestnut timbers bedded in the

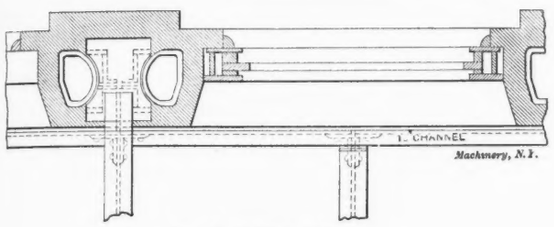


Fig. 2. Section of Walls.

concrete. A section of the floors is shown in the sketch in Fig. 1, a detail of the roof in Fig. 3, and a section through the pilasters and a window, showing the flues, in Fig. 2.

In the fittings of the buildings, the benches are the same as listed in the Brown & Sharpe catalogue and regularly sold. Another convenience of considerable importance is the provision for drinking water in the different buildings. Artesian well water is supplied, and faucets are located at frequent intervals, the piping running up beside the iron columns of the buildings. To catch the overflow, and to serve, incidentally, for washing purposes, bowls are attached to the columns, under the faucets, by iron brackets. The water is drained from these bowls and drinking cups are provided.

Power Transmission.

The main source of power for the works is a 500 horsepower Rice & Sargent compound engine, placed about midway between the two chimneys that rise from the main building, as seen in the general view. The distribution of the power is somewhat unusual, and is indicated in the sketch in Fig. 4. The main idea was to belt from the engine, as directly as possible, to the centers of power consumption. To do this the face of the bandwheel of the engine had four crowns turned upon it, and four independent belts extend to the main jack shafts, the distance to shaft *A*, Fig. 4, being about 84 feet, and to *B* about 86 feet. Binder pulleys are used to cause the driving belts to have as large an arc of contact as possible upon both driving and driven pulleys. While, among some engineers, there is a prejudice against the use of binder pulleys, the experience here has been very favorable. It has been found

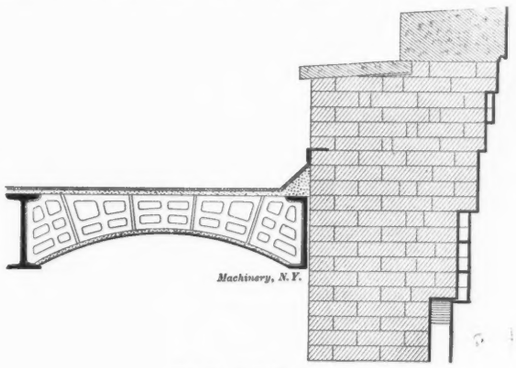


Fig. 3. Detail of Roof.

that when the load is on, the belt tends to follow the full arc of contact of the pulleys, and that the binder pulleys exert but little pressure upon the belts.

In the new building a second Rice & Sargent engine is being installed, and there is in operation, also, a power plant in connection with the No. 2 building to supply power to this and the No. 3 building.

The design of these various buildings is unusual in several respects. The original structure, erected in 1872, was so well thought out, and so well adapted to the needs of a manufacturing machine shop, that in the succeeding buildings it has been possible to adhere to substantially the same construction, both in respect to appearance and to its various features, except in so far as improved methods of building construction have changed the methods of building. Thus, while the floors of the first building were supported by the walls and cast iron columns were employed, the latest building is of steel frame construction, with structural steel columns, and with improved systems of heating and ventilating. The first building, however, was essentially fireproof, and was not only far in advance of the usual building practice of its day, but is still a better building than is often found for manufacturing purposes at the present time.

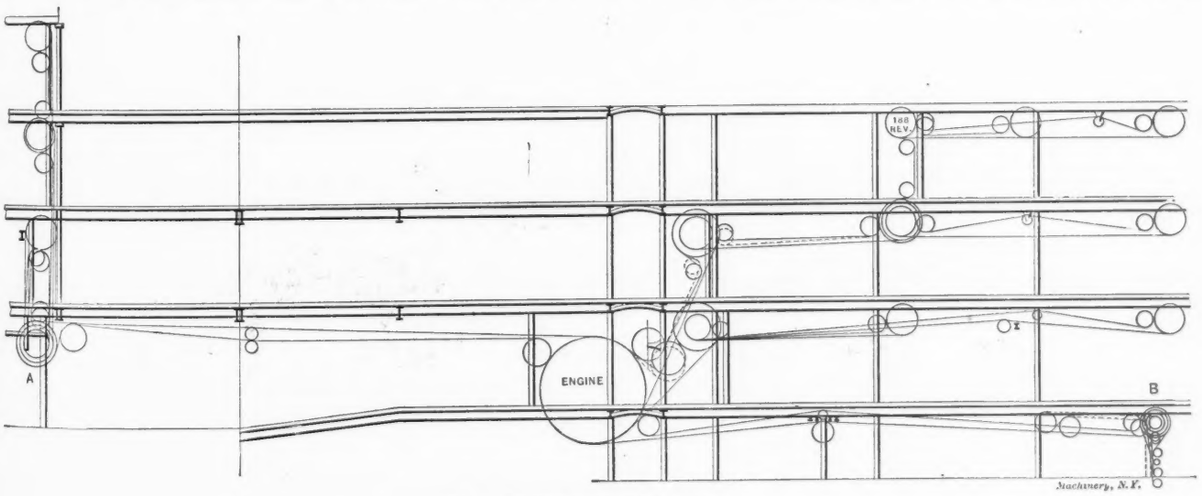


Fig. 4. Power Transmission System.

Fig. 9. Automatic screw machine erecting room, showing a lot of fifty machines nearing completion.

Fig. 10. Automatic screw machines in operation, showing the Brown & Sharpe No. 1 automatic screw machine in the foreground. There are about thirty-five automatic screw machines in this department.

Fig. 11. View in gear cutting department. Besides the automatic gear cutters and milling machines, there are several gear planers, special machines for cutting spur gears, bevel gears, etc.

Fig. 12. Milling department, showing No. 13 milling machines operating on micrometer caliper frames and sewing machine parts.

MACHINE TOOLS, THEIR CONSTRUCTION AND MANIPULATION.—18.

GRINDING MACHINES.

W. H. VAN DERVOORT.

Grinding operations in the machine shop depend upon the abrasive or cutting qualities of stone, emery, corundum, and carborundum, when suitably held and presented to the work. The use of the solid grinding wheel has made it possible to attain many refinements in machine construction that would

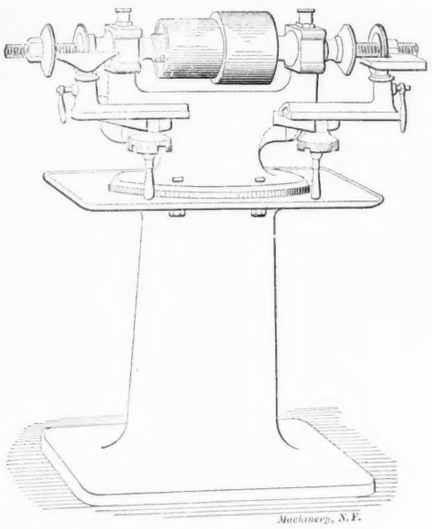


Fig. 166.

have been impossible without it. It has made it practical to ecomomically finish parts in hardened steel that could not possibly be machined with cutting tools in the lathe or planer; and on the softer materials, surfaces smoother and truer can be obtained by grinding than by any other method.

Grinding operations may be divided into the following classifications: 1st, hand grinding; 2d, tool and cutter grinding; 3d, cylindrical grinding; 4th, surface grinding. Hand

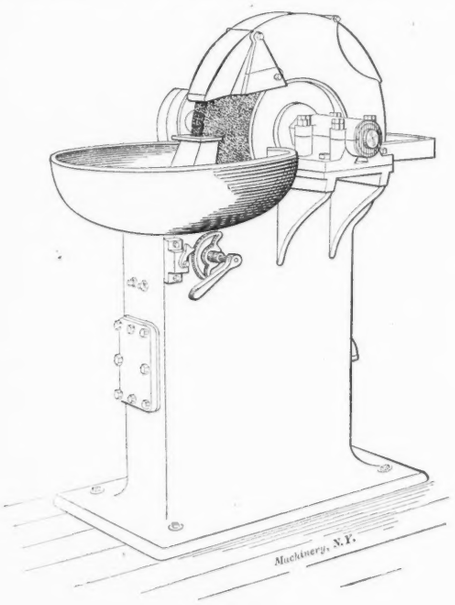


Fig. 167.

grinding includes all the grinding operations in which the work is held to the wheel by hand or without a rest, as in rough grinding, ordinary lathe tool grinding, buffing and polishing. The class of machine used for this work is of the simplest form, consisting of the wheel-carrying spindle mounted in suitable bearings on a substantial head or pedestal. In Fig. 166 is shown a simple grinding stand, designed to carry two wheels. It is provided with adjustable rests upon which the work being ground is steadied. This grinder is intended for dry grinding of the rough and heavy class, where there is little danger of heating the work.

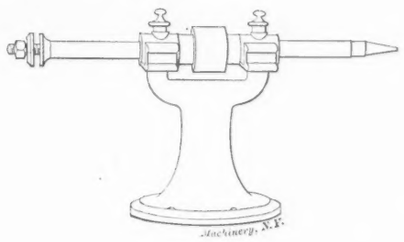


Fig. 168.

When tempered work is to be ground, or any class of work that would be injured by heating, a wet grinder of the class shown in Fig. 167 is used. With tools of this class a supply of water is delivered constantly to the rim of the wheel, thus keeping the work cool. Fig. 168 shows a buffing head or spindle. The spindle extends well out from its bearings for convenience in handling the work being operated upon. These

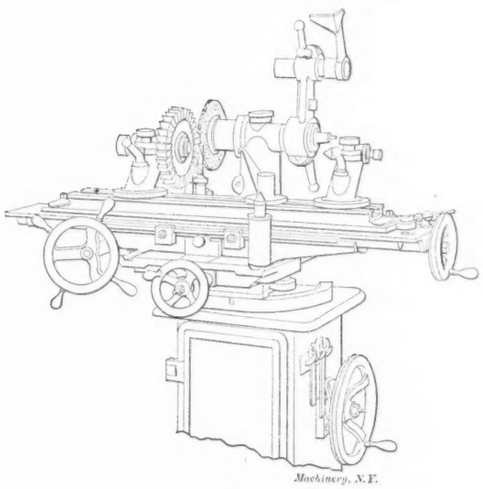


Fig. 169.

spindles are fitted to receive wheels of wood, leather, or cloth, which are charged with the emery or other grinding material. The work is held to the wheel without the aid of a rest.

Tool and cutter grinding requires a better class of grinding machinery than is required for the hand-grinding operations.

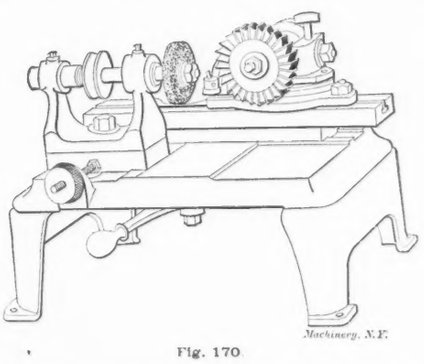


Fig. 170

What is here referred to as tools does not include the ordinary hand and lathe tools, commonly ground on the machine shown in Fig. 167, but refers to drills, reamers, milling cutters, and the finest class of tools. Fig. 169 illustrates a universal cutter and reamer grinder. As the name implies, these tools are provided with all the necessary adjustments and attachments for grinding the cutting edges of all classes of reamers and milling cutters, and in many cases may be used for doing

The illustrations in this article represent machines of only a few of the manufacturers of grinding machinery. The selection was made by Prof. Van Dervoort mainly with reference to convenience in obtaining the illustrations, and the intention is to show representative types, only, without regard to the special mechanical features of the different machines.—EDITOR.

a limited amount of cylindrical grinding, both internal and external. A much simpler machine, shown in Fig. 170, constitutes a very satisfactory cutter grinder of small proportions. By the use of the swivel head shown, cutters of all angles may be readily ground, and by placing centers on the slide which is operated by the lever shown under the table, reamers up to the capacity of the machine may be ground.

The grinding of twist drills is a very particular operation, requiring a skilful operator, if performed by hand. In Fig. 171 is shown a twist-drill grinder in which the twist drills may be ground with the assurance that the angle and clearance will be correct and equal on both sides. Grinding machines for the grinding of common forged lathe and planer tools are manufactured, and in shops where large numbers of forged tools are used have proved very efficient. In the work-

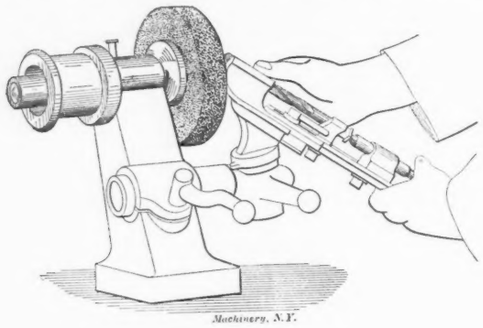


Fig. 171.

ing of these grinders, the tool is clamped in a suitable head and presented to the emery wheel at the proper angle to give, for any class of tool, the proper rake and clearance.

Cylindrical grinding, as a class, covers all forms of grinding operations upon external and internal cylindrical surfaces. The universal grinding machine, or, as it is sometimes termed, grinding lathe, shown in Fig. 172, is specially adapted to this very exacting class of work. All machines of this class consist of a platen carrying a suitable head and tail stock, and of a wheel stand carrying the grinding wheel. The arrangement of parts is such that either the wheel stand is given the feeding motion past a stationary platen, or the platen is given the feed past the wheel. The adjustments are such that the wheel can be set in or away from the line of the work center, or can be turned to stand at any desired angle with the line

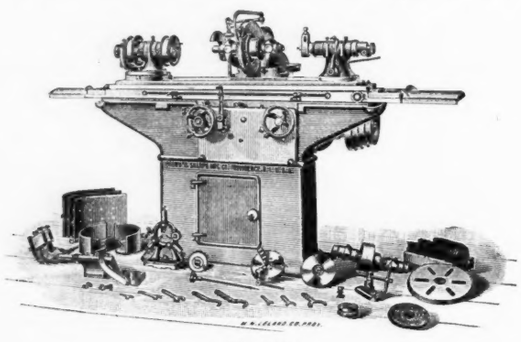


Fig. 172.

of the feed travel, which is necessary for face and steep angle grinding. The platen can be set at an angle with its travel, or the line of travel of the wheel where the platen is stationary, thus making possible the grinding of long tapers. For internal grinding, a small spindle, run at a high rate of speed and carrying an emery wheel small enough in diameter to operate in the bore to be ground, is used. These machines are provided with suitable pumps for supplying an abundance of water to the wheel and work, when the character of the work is such as to require it. As these machines are expected to produce work smooth and cylindrically true, they are most carefully built, and should embody all the refinements known in machine tool construction. The spindle for carrying the emery wheel is perfectly balanced and runs in very close-fitting boxes, as any slack in the bearings or lack of balance proves fatal to the production of correct results. Provisions are made for rotating the work, when held between dead centers with a spring tension adjustment on the tail center, thus reducing the danger due to expansion and the unequal wearing of the center bearings. The screw adjustment for setting the wheel up to the work is graduated to thousandths of an inch, thus forming an excellent guide in determining the amount of stock removed.

Surface grinding bears the same relation to planing that cylindrical grinding does to turning. The surface grinders use the same form of wheels as the cylindrical grinding machines. The work, however, is secured to the platen or work table, which is fed under or over the wheel. In Fig. 173 is shown a surface grinding machine. The construction of the machine is clearly shown. The wheel is adjustable vertically to give depth of cut, the arrangement of pulleys being such as to give constant tension on the belt for all positions of the wheel. The cross feed is obtained by moving the table toward or away from the housings on suitable cross slides. Provisions are made for supplying water to the wheel when necessary.

In Fig. 174 is shown a plain grinder provided with a surface grinding plate. In this case the wheel projects above the surface of the plate only the amount of the cut required, and the work is passed over it by hand. To give satisfactory results, the spindle and its bearings should be first class, and the

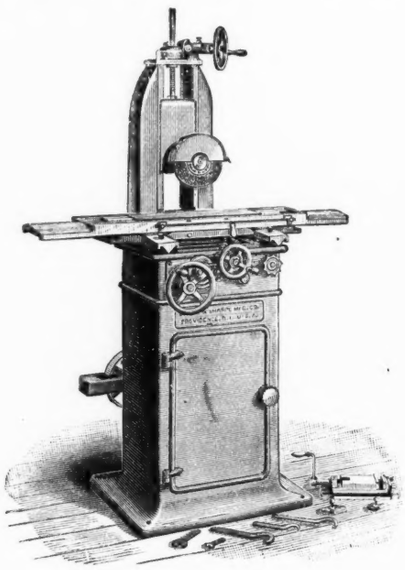


Fig. 173.

wheel in perfect balance. A grinder of this class is a most satisfactory tool for smoothing and polishing surfaces where finish and not truth is required. A more refined grinder, somewhat after the same order, and known as a disk grinder, is shown in Fig. 175. These are very nicely constructed grinders in which the grinding is done by sheet emery glued to the faces of the disks. The rests swing across the face of the disk, the work being held on top of the rest. For the finishing of one or more plane surfaces on small parts, this tool is very well adapted.

The wheel for any class of grinding should be properly adapted to its work as to shape, grade, and hardness. The shape and character of the work determine in any case the shape of the wheel to use; while the material of which the work is composed, the amount of metal to be removed, and the condition of the finished surfaces must determine the quality of the wheel. Emery and other wheels of that class are composed of two elements—the abrasive and the cementing materials. The cement—as clay, glue, or rubber—holds together the grains of emery, and in use, as the grains become worn and dulled, they break away from their settings in the cement, and fresh grains are uncovered to go on with the cutting process. If this breaking down process is comparatively rapid, the wheel cuts very freely, but reduces in diameter correspondingly fast. If the cement, on the other hand, does not give up the worn grains of emery, the wheel glazes,

cuts slowly, and heats the work. The surface velocity of the wheel should be correct for the different classes of work and grade of wheel. The wheel is ordinarily most efficient just before it stops breaking away and begins to glaze. Up to this point, the higher the speed the more metal it will remove in a given length of time. When run at lower speed, it cuts somewhat easier, and does not heat the work as badly. Glazing is usually prevented by reducing the speed. Soft wheels stand up better at high, than at low, speeds. The wider the

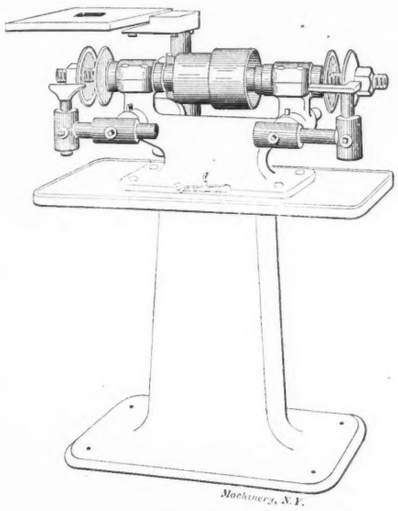


Fig 174.

faces of the wheel presented to the work, the more cutting surface, and the faster the metal is ground away. The feeds must be correspondingly coarse. The wider-faced wheels should be comparatively soft, and as the face reduces in width the wheel should increase in hardness.

The surface speed of the work should be proportionate to the speed of the wheel, and in any case should be sufficiently slow to allow the wheel ample time to cut away the metal without crowding, as otherwise the work is sprung away from the wheel more or less, and untrue work results.

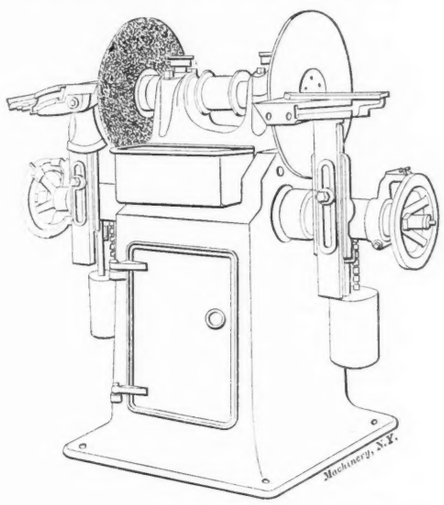


Fig. 175.

A free cutting wheel, run at the proper speed and with a light cut, is best for accurate grinding, as it removes the metal without pressure and consequently cuts the high spots most and does not heap up the work. It is, however, necessary on very accurate work to use water on the wheel, as a slight change of temperature affects the work noticeably. When long cuts are to be taken, it is sometimes difficult to get the wheel to stand up so as to give a parallel cut. In such cases, the wheel must be properly adapted, and each grain of emery must cut as long as possible before dropping out. As the harder wheels hold the emery longer, and can be run somewhat slower, they are best adapted to this condition. The wheel should have a wide face, and should be of large diameter, so as to present as many grains of the abrasive as possible to perform the required work. It is also necessary to use the coarser feed and light cuts in order that the wheel may cover the entire surface before it drops materially in diameter. The direction of feed is changed for each time over the work, which also tends to even up the wear on the wheel.

All manufacturers of grinding wheels, however, give a table of speeds for the different diameter of wheels they manufacture, but these speeds are not always best suited to the work. All wheels should fit easily, yet closely, on their spindle to prevent danger from cracking, and a soft washer of uniform thickness should be placed between the sides of the wheel and the clamping washer. The wheel should be firmly clamped and trued before using. Manufacturers test all wheels by running them at a speed considerably above their rated speed.

* * *

FOUNDRY METALLURGY.

A CONSIDERATION OF THE CONDITIONS NECESSARY TO ITS SUCCESS.

HERBERT E. FIELD.

No department of foundry practice has caused as much discussion as to its merits or demerits as that known as Foundry Chemistry, or Foundry Metallurgy. One concern considers it an indispensable adjunct to its foundry, while another is as strong in its condemnation. The metallurgist in our foundries has not been an unqualified success in all cases. This statement cannot be denied even by his stanchest supporters, and it will not come amiss if we give a little time to the study of the causes which have brought about this adverse opinion.

In those foundries where metallurgy has been successful it has proved a great saving and an aid to improved work. Starting with this as an admitted fact, I shall endeavor to show why it has failed in other cases and thus help to point out those things to be avoided in foundries where this method of mixing iron is being considered.

Failure due to Inexperience of Metallurgist.

Our scientific, technical and industrial colleges are graduating each year so-called industrial chemists. These men are, to a considerable extent, being taken into our foundries as foundry metallurgists. They have been taught the value of experimenting, how to think, and how to put their thoughts into results, and have learned how to analyze iron. Such men are good stock to work on, but that is about all that can be said. Their knowledge of metallurgy consists of the definitions of pig and cast iron and a description, more or less antiquated, of the manufacture of iron and steel. They have been taught that in some unaccountable way silicon softens iron, sulphur makes it red short, phosphorus makes it fluid and that manganese makes it hard or soft, strong or weak, depending upon what authority their professor has drawn for his notes. They know that there is carbon in iron, that combined carbon makes it hard, and graphitic carbon makes it soft. These are their whole stock in trade. Such graduates hardly know how a pig of iron looks and are wholly ignorant as to the amount of the different elements which go to make up the best mixtures for different grades of castings. Furnace changes are unknown quantities, and the lack of knowledge of the hundred and one difficulties that the foundry metallurgist has to contend with, makes them at the start wholly unfit for the places which the employers wish them immediately to fill.

It is just here that this method may be made a success or a failure. Too much should not be expected at first; time and patience alone will bring success. Books and current literature will furnish little or no help in foundry metallurgy. The young chemist has practically to work out his own destiny as a metallurgist just at this point, and this is not the work of a week or a month, but of many months of failures before success commences to reward his labors. Many employers, not willing to wait, make here the mistake of condemning chemistry without giving it a fair trial; yet it can be made a success under these conditions. It should, however, be remembered that the young graduate knows practically nothing of the nature of cast iron and the conditions which surround its melting and mixing. If he does not realize

this, it should be impressed upon him. He should be required to analyze the iron in use in the foundry, to figure out the percentages of the various impurities, and then to analyze the resulting castings. This should be done with as many different grades of iron as the foundry uses in its daily work, and should be continued until the exact percentages of loss or gain of the different elements have been determined. A small cupola for experimental work is of great value in a modern foundry, for, in this, trial heats can be run off. The next few years will see a great advance in the methods of mixing and melting iron, and it will be the firm that is willing to experiment that will be the first to profit.

Having once learned the effects of the various elements on the strength and character of iron and the action of the cupola upon the iron in melting, the most important step has been accomplished. This often seems a long process to founders. It is, however, the only method at present open to those not willing to pay the salary that an experienced metallurgist can command. In reply to a question often asked, as to the time it would take to fit a young chemist in this manner, I have invariably said that it depended much upon the man, but more upon the conditions and surroundings in which he worked. It takes a great deal of hard work, many failures and discouragements, and, be it success or failure, it must be equally shared by employer and employee. This brings us to the point where we may well consider the question which is being discussed in some of our journals, viz., "The Better Preparation of Foundry Metallurgists by our Technical and Industrial Colleges."

There are small foundries connected with many of our technical colleges, and some of them are fairly well equipped. There is, however, but little, if any, connection between the metallurgical and foundry departments. The foundry is generally operated by a practical moulder who gives the students instructions in simple moulding and core work, and perhaps shows them about the construction and care of a small cupola. The metallurgical department is conducted by a member of the faculty who has probably never seen the inside of a large foundry, and whose notes are derived from old authorities with perhaps a note or two picked up from some of our scientific periodicals.

There are two questions upon which the success of this method of training foundry chemists depends. First: Are these institutions ready to take hold of the matter and pay the salary that a man competent to do this work would expect? Second: Could men be spared from foundry work who have the required amount of experience, and who have acquired a sufficient knowledge of this subject to make the teaching of it a success? If these two questions can be answered in the affirmative there is but little doubt that an institution which has a cupola and a foundry could supply, at the end of the course, students who would be competent to go into a foundry with a saving of at least a year of experimental work. These students could, under the direction of such an instructor, analyze the pig iron, make up the mixtures and analyze and test the result. They could have a knowledge of sampling of pig iron, and of the proper way to fit up a laboratory for foundry work. In fact, they could be made familiar with the chemistry of general foundry work. The newness and lack of experience is one of the hardest things which the chemist has to overcome in his first foundry practice.

The good that might come and the progress that might be made in this same metallurgy can hardly be estimated, if it were taken up under proper direction by our industrial colleges. Expert foundry metallurgists admit that there is a great deal more to be learned in this line. The advance investigation, however, has to be carried on in spare moments of which there are but few in a foundry laboratory. If, however, it were taken up by the colleges, where a scientific research rather than dollars and cents, is the principal object aimed at, much more would be learned and added to our practical knowledge of the subject. The experimenter, with time at his command, and ample facilities for analyses, and practice, could work out some of the problems which are now bothering foundry metallurgists. This is perhaps sufficient to give a brief idea as to how the graduate chemist may be made use of at the present, and what the possibilities are for the future.

Failure due to Surrounding Conditions.

From considering the difficulties due to the inexperience of the metallurgist, let us consider the other side of the question. There are many chemists who have given years to solving the vexed questions which arise in connection with foundry metallurgy; who have not only studied the theoretical side of this question, but have spent much time applying it to cupola and foundry work. It is the men who have been willing to undergo the discomforts of bringing the theoretical and practical sides of foundry metallurgy into agreement, who are having success in this line of work.

It should not be considered, however, that the foundry metallurgist is a "wizard" or that he can accomplish the impossible. Some foundrymen appear to think that it is only necessary to turn a chemist loose in their foundry, and that hard iron will be changed to soft, and weak iron to strong; while others go to the opposite extremes, giving opportunity for a second cause for failure. The metallurgist thus stands in a difficult position. Often his success, which in a large measure is dependent upon himself, depends also upon the hearty co-operation of others in the works. There should be a perfect agreement and understanding with the purchasing agent, or buyer of the original pig and scrap. While a metallurgist may, upon analysis, much improve the mixtures, yet this is often made difficult, owing to the fact that the iron furnished is wholly unfit for the work. The co-operation of the foundry foreman is perhaps even more necessary to the success of this method, and this brings us to another frequently discussed question.

Divided Responsibility.

It is here, perhaps, that metallurgy has met with more opposition than at any other point. The majority of foremen pride themselves on their ability to mix iron. Is it to be wondered at, then, that they look with suspicion on the young metallurgist who has learned in a few years what it has taken them a lifetime to accomplish? Some foremen appreciate the advantage of metallurgy, and in those foundries it can be made a success. It is impossible for a metallurgist to be an unqualified success in a foundry where he is obliged to contend against a foreman, while in the majority of cases where the metallurgist and foreman work in conjunction, this method of mixing iron is found wholly satisfactory.

The "divided responsibility" question is at best a difficult problem, and one which each foundry will have to work out for itself. The simplest solution of the matter appears to lie along the line of the education of the foundry foreman into the chemical methods of mixing iron, rather than to try to get the average chemist to give the time necessary to acquaint himself with cupola practice and moulding, after having given from four to five years to the study of chemistry. This would make the chemist responsible for the analysis work, and the foreman responsible for its application to foundry work. It is, however, a difficult matter to uproot the theories and practices of from ten to forty years of mixing by fracture, and to substitute the more accurate chemical methods. It is hard to convince one who has not been trained to consider the minutest quantities of utmost importance; that one per cent. or less of carbon, silicon, sulphur, manganese or phosphorus can change the whole character of the other ninety-nine per cent.; and yet such is the case. Modern foundry practice is advancing along so many different lines that it is almost impossible for a foreman to keep up with the times with foundry methods and still devote sufficient time to metallurgy to make its use a success. Mixing iron by chemical methods necessitates much more care in charging the cupola than is generally used in the older methods of mixing by fracture, and would frequently take much of a foreman's attention just when it could least be spared from other work. These reasons have led many of our large foundries to give an experienced metallurgist entire charge of mixing and melting of the iron. With an assistant to do part of the analytical work, he is given ample time to see to the carrying out of his mixtures and the condition and quality of the resulting castings. This is without doubt the reason why metallurgy has been more successful in the larger foundries. The smaller

foundries, not able to pay the salary of a metallurgist and chemist, are obliged to get along with the one, who may be wholly unable to do the amount of work necessary or may be incompetent and thus cause failure of the method. There are still smaller foundries whose output will not warrant the employment of a resident chemist whose needs will have to be considered in the near future, and it will be interesting to watch the development of the plans for establishing a laboratory in Philadelphia for the general use of those foundries that have no resident chemist.

The Pig Iron Merchant—Furnaces

There is one more condition which works against the foundry metallurgist, and that is the pig-iron merchant or agent. There was a time, four or five years ago, when foundry metallurgy was just beginning to spread out and analyses were being made more universally at blast furnaces, that the agent said, "Just tell us what analysis you want and we will supply you." That was before the foundryman really knew what analysis was best fitted for his work. At present metallurgy has become more advanced, and as the foundryman has learned at least what he does not want in his iron, and draws restrictions as to sulphur, silicon, etc., the merchant is less anxious to supply iron by chemical analysis. He now claims that analysis cannot be depended upon, that no two chemists analyze alike, and quotes, I must admit, some examples of apparent contradiction in the chemists' work. Many times, however, these have been found to be due to irregular samples rather than to incorrect work.

The lack of knowledge of the various agents with regard to the effects of the different elements in the iron which they sell, is frequently a great drawback to the advantageous purchasing of iron by chemical analysis. They often state that the furnace cannot supply a certain analysis of iron, when it is more frequently the case that the agent is unable to make the furnace men understand the requirements of the customer. Finally the furnace men themselves frequently make it difficult to obtain iron which shall answer the requirements of a specified analysis. If a furnace is rushed and can sell iron as fast as it is made, regardless of quality, there is little to induce them to get their iron to stated requirements. When a furnace is slack and looking for orders, much closer specifications will be filled and filled eagerly. Not that the furnace cannot make iron to certain analysis, but it is generally a case of "will not." There appears little hope that the remedy will come from the furnace, and hence it must come from the foundries. When every foundry buys iron to a specified analysis, and insists on the requirements being fulfilled, then the furnaces will begin to make iron to meet those requirements.

In the above article the writer has endeavored to point out the chief obstacles to be overcome in the successful practice of foundry metallurgy. If founders will give proper consideration to the thoughts brought out, they will meet with far better success in the introduction of this most important branch of foundry practice.

* * *

HAND TAPS WITH SPIRAL FLUTES.

In a recent issue of the *Mechanical World*, a correspondent illustrates and describes a spiral-fluted tap as shown in Figs. 1, 2 and 3, and states, in connection with the description, that this form of tap is patented and manufactured by the Danish firm of Nienstaedt & Co., Copenhagen, Denmark. He also states that it is patented in England, and describes it as follows:

"Its peculiarity consists chiefly in having spiral flutes, which are a radical departure from the usual straight tap flutes. It is well known that a tap with straight flutes gets choked up with chips, which hamper its movements and render the labor of turning much harder. There is nothing in the action of the straight flutes to cause the chips to rise up. The pressure of a quantity of accumulated cuttings is all that will force them up the flutes of the tap, and by the time this pressure is reached the cuttings are jammed tightly and cause much friction. It becomes necessary, therefore, to withdraw the tap and frequently clear the hole. But with spiral grooves the tap itself does a good deal of the clearing as the cuttings naturally creep up the slope; in fact, they are screwed out of the hole as with a spiral conveyor.

"To aid this clearing the first tap is made with the end shaped like a drill for a little distance up. In tapping a deep blank hole this smooth cutting edge starts the chips on their upward course, and prevents them falling to the bottom of the hole. A little oil assists them to slide up easily. The drill point also sizes the hole ready for the thread. Another advantage of the spiral form is that it tends to help the tap into the work, which is a great thing when starting.

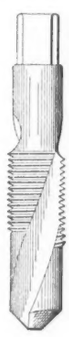


Fig. 1.

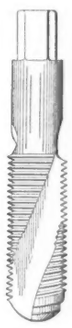


Fig. 2

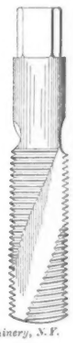


Fig. 3.

"The effect of the spiral on the cutting edges is, of course, to give a shearing cut, which makes the labor of tapping much easier, and brings the metal out in regular shavings, making the work of tapping a pleasure. These taps are patented in England as well as in other countries, and are made to standard Whitworth thread. The illustrations show the entering tap combined with a drill point, Fig. 1; the second tap, Fig. 2; and the bottoming tap, Fig. 3. Each tap has two flutes."

The editor recalls seeing some old taps with six spiral flutes in the toolroom of a railroad shop several years ago which had been made many years before, but which were not then in use, as they were unrelieved and besides were not of standard thread. Although impressed with the value of the idea, there appeared to be no evidence that this form of tap possessed any merit over the straight-fluted ones, the above notwithstanding.

* * *

We believe that it is not generally known that the best "cellulose," the material used for backing up the plates at the water line of war vessels, to prevent the inflow of water when the plates are pierced by shots from the enemy, is made from cornstalks. The pith of the cornstalks is treated chemically to make it fireproof, and is pressed into shapes suitable for use. It is packed between the inner and outer walls of the warship. A few years ago the experiment was made of firing a 250-pound projectile through a steel cofferdam packed with cellulose three feet thick. A hole was made a foot in diameter. Water was immediately turned on, and continued for an hour, at the end of which time not a drop had gone through. The cellulose has the property of absorbing the water rapidly and swelling to such an extent as to close an opening of considerable size.

* * *

A mighty work of engineering is that of damming the River Nile, at Assuan, Egypt, near the first cataract. The river at this point is nearly one mile wide and the great dam will make a reservoir more than 140 miles long. From the dawn of history in this land of mystery and romance a "low Nile" has meant hunger and death to the people; a "high Nile" plenty and prosperity. Now all will be changed. Every year will be one of plenty, as the volume of the life-giving flood will each year be the same. The mighty Pharaoh, with his absolute control of the fate of millions of subjects, could apparently find no better object than the building of a great pyramid to perpetuate his memory. The modern engineer yields nothing in power to the ancient Pharaoh, as he is master of forces then undreamed of; yet how different are his aims and ideals. The greatest monument to his memory that any one can now erect is a work of enduring benefit to mankind.

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APRIL, 1901.

CIRCULATION STATEMENT.

MACHINERY has the largest paid circulation in its field in the world. It reaches all classes—journeymen, foremen, draftsmen, superintendents, employers; and covers the machinery field thoroughly. The regular editions of MACHINERY for the past twelve months are given below, and any advertiser in the paper will be afforded every facility to verify the correctness of these figures:

1900.		1900.		1901.	
May	21,500	September..	21,750	January	27,500
June	27,500	October.....	24,000	February	26,500
July	22,000	November...	25,000	March	30,000
August	21,500	December...	27,500	April	26,000

THERE IS NOTHING IN IT.

The *Electrical Review* appears to be a radical advocate of international secrecy regarding manufacturing and the various processes connected therewith. It says:

"It seems likely that we have succeeded so far rather in spite of our generous disdain of secrecy, than on account of it. Certainly we can not afford, in view of the fierceness of the competition that the next few years will bring, to get out of our way to grant advantages to our adversaries. It would be pleasanter, perhaps, if we could be generous, but it is an open question whether or not we can afford to be generous, and to give away to the world at large the secrets and methods that are rapidly making us pre-eminent in manufacturing. We are so proud of our industrial establishments that we are tempted to make them places of entertainment for visitors who come, not only to see and learn, but to return home and copy. The practice of admitting visitors of this character is peculiarly American, and such courtesies are not returned to those of us who visit European workshops. It may be true that we can afford to show our hand, but if conditions arise that make competition keener this very fact of our willingness to tell other people how we do it may prove the deciding factor against us in the struggle for commercial supremacy."

The foregoing is apparently based on the assumption that commercial success in manufacturing primarily depends on secrecy. If this is true, why advertise, or, better yet, why sell products? The imitative rival at home or abroad who is bent on stealing ideas and markets from another, will in some way find means to examine his machine for points even if denied knowledge of his manufacturing methods. To get the best of such rivals (if this idea is carried to its logical conclusion) the obvious plan would be not to manufacture for sale at all, but merely for private amusement, and, incidentally, to keep the workmen from starving to death.

It is a matter of common knowledge that the wealth of a country consists in its natural resources and the character of its people. What country has the natural resources of the United States, and what people such inventive and forceful characteristics? We sincerely believe that a policy of secretiveness would be the surest one to invite a decadence in manufacturing. We need fear little from imitation so long as we have cheap raw materials and a progressive spirit.

If secrecy is such a good policy, why have the English manufacturers fallen behind? The medicine evidently has not agreed with the foreign patient, and we fail to see why it should be prescribed for the healthy American manufacturer.

* * *

GIVE CREDIT WHEREVER IT IS DUE.

A contributor to the *American Manufacturer* comments on instances where he has observed that college graduates have not succeeded in handling men. He believes that in many cases these graduates are inclined to forget that what the mechanic may lack in education he may compensate for by his practical knowledge of his trade, and adds that the mechanic knows that the college graduate has gained only a theoretical knowledge of mechanical pursuits at college, and is ready to resent any action of his which tends to assert his superiority as a man or a mechanic. He says that "the successful manager or foreman is the man who thoroughly understands the mechanical pursuits in which he is engaged, and has acquired the knack of not driving, but leading, men to do his bidding.

"Such a man does not quarrel with his men, or do anything to humiliate them in the presence of his fellow-workmen. When their work or conduct is not satisfactory, he goes quietly to the workmen, and advises or instructs them what to do to improve matters and make affairs satisfactory."

All this is well and good, and the writer goes on to formulate a number of rules that a person must follow to become a successful manager. He emphasizes that one must control his temper, be firm and polite, etc., etc., which is also well and good, and finally adds:

"Always remember that you do not know it all, and cultivate the habit of learning from workmen under your charge, and others, all you can without exposing your own ignorance. Learn to apply such knowledge *without giving others credit, and to improve upon it or present it in such a way that the man from whom you obtained the knowledge will not recognize it as his own*, and will give you credit for knowing more than he did."

We cannot imagine worse advice to a young man who aspires to rise as a manager of men, and who hopes to hold his self-respect and the confidence of those about him, than that contained in the last paragraph. Does the writer of the article referred to suppose for a moment that such action on the part of a manager, superintendent or foreman will go unnoticed? And does he suppose that when it is discovered, as it will be, that he is using the ideas of others and is taking the credit himself, it will add to his influence over those who have heard of his methods? There is,perhaps, no one thing in which people oftener try to deceive themselves than in the belief that they can enhance their influence by taking other people's ideas and assume to know more than they do, by taking the credit also. A manager who is willing to learn from the lowliest about him, and is willing to give even the most humble their just dues, will lose nothing in dignity, will be more respected, and will exert more influence than one who does not; because he is actually just what he appears to be, and because his ways are as just to those below him as to those above.

NOTES AND COMMENT.

The immense floating dock that is being built at Sparrows Point, Md., for the United States government, and which is to be located at Algiers, La., is of steel, 525 feet long, and has a depth on the sills of 28 feet. It will weigh 5,850 tons, and will be one of the largest floating docks in existence. The largest dry dock in the world is at Liverpool, England, and is 925 feet 6 inches long.

The Holland submarine boats now building for the United States navy are to be equipped with gasoline engines for their propelling power. The engines are of the inverted marine type, with four single-acting cylinders of uniform size. The engines are to develop 160 horse power at 360 revolutions, and a recent test of one of them showed the consumption to be .88 pint of gasoline per brake horse power. Each engine is provided with a starting arrangement consisting of a small hand pump, a tank with valves for mixing air and the vapor of gasoline, and suitable valves for admitting a charge of this mixture from the hand pump to each engine cylinder. A few strokes of the pump and the ignition of the charge will start the engine if the pistons are in the correct position. In the trial mentioned the only objectionable features were the noise of the exhaust and the radiation of heat from the exhaust pipe. When on shipboard the exhaust will be below water, which will remove one objection, and the exhaust pipes will be water-jacketed with circulating water to reduce the radiation.

The original transmission line between Niagara Falls and Buffalo, erected by the Niagara Falls Power Co., consisted of three copper cables of 19 strands each, strung on poles 75 feet apart. Later three more cables were added, affording two three-phase transmission systems. A new transmission line is now in progress of construction, which will parallel the old line most of the way, but which will be three miles shorter owing to a change in the course at the Buffalo end of the line. The interesting feature of the new line is that it is of aluminum, furnished by the Pittsburg Reduction Co. There are three cables, each with 37 strands, making larger cables than the older ones of copper. Their conductivity, however, is expected to be about the same, and the lightness of the aluminum makes it possible to increase the span between the poles to 112 feet. The *Electrical Review*, in describing this line, states that power is now transmitted to Buffalo at a voltage of 11,000, but as soon as the new line is completed the voltage on both lines will be made 22,000. It will then be possible for the Niagara Falls Power Co. to transmit 30,000 electrical horse power to Buffalo, and this amount of power will be ready for the Pan-American Exposition.

Some of the most important tests made during the past year upon the Emery testing machine at the Watertown (Mass.) Arsenal have been summarized in the *Journal of the American Society of Naval Engineers*. The following results taken from this summary will be of interest.

The tensile properties of the steel used in the jackets and tubes of the larger guns are about as follows: Elastic limits from 45,000 to 55,000 pounds per square inch, tensile strength ranging from 85,000 to 95,000 pounds, with an elongation after fracture of 20 per cent, and contraction of area 40 per cent or more, measured on a specimen three inches long.

For small arms, the barrel steels have an elastic limit generally above 70,000 pounds, with the tensile strength ranging from 110,000 to 120,000 pounds per square inch.

A special tungsten-steel had an elastic limit of 101,000 pounds and tensile strength 125,500 pounds, the elongation being 19 per cent and contraction of area 34 per cent. This steel contained 1.94 per cent of tungsten and 0.72 carbon.

Steel castings used in the mounts of 6-pounder and 15-pounder guns had a tensile strength of from 60,000 to 70,000 pounds.

Cartridge brass, in sheets about ⅛ inch thickness, showed an elastic limit of 16,000 pounds, a tensile strength of 46,000 pounds, with the exceptional elongation of 60 per cent on a 10-inch section. The composition of this metal was: Copper, 70; zinc, 30.

A STANDARDIZING BUREAU.

At the last session of Congress a bill was passed establishing a national standardizing bureau, which is to be organized and located at or near Washington, D. C. The chief duties of the bureau will be the comparison of standards used in scientific and engineering work with government standards; and the testing and calibration of standard measuring instruments. The bureau will be at the service of any State or municipal government, scientific societies, colleges, and firms or individuals engaged in manufacturing, or in other pursuits, in the United States requiring the use of standards. Prof. S. W. Stratton, of the University of Chicago, has been appointed Director of the new bureau, and he will have an ample corps of able assistants. A representative of the *Iron Age* recently interviewed Prof. Stratton on the subject, who outlined some of the possibilities of the new institution.

It is expected that the bureau will be of great service to manufacturers of iron and steel where the use of pyrometers for measuring extremes in temperature has come to be a necessity. At present it is difficult to obtain an accurate calibration of these instruments in America, and the bureau will attempt to supply this deficiency. Another important work will be the calibration of steam indicators and gages to be used on important tests. Prof. Stratton also says that while it will not be a function of this bureau to determine the proper gages for wire, metal plates, the pitch of screws, etc., they will be in a position to compare these instruments with the government standard and calibrate them. The bureau may also be of service in the settlement of disputes, and it will be in no way an attempt to compete with private enterprise, no favoritism will be shown, and the schedule of fees will be reasonable.

THE BERLINER PATENT CASE.

The recent suit of the American Bell Telephone Co. against the National Telephone Co. in the United States Circuit Court at Boston, with reference to the famous Berliner transmitter patent, was one of the most important on record in point of the interests involved.

The patent was filed in 1877 and pended in the Patent Office for more than 14 years, during which time the Bell Telephone Co., under the patents of Alexander Graham Bell, had a monopoly of the telephone business in the United States. In 1891 the Berliner patent was finally issued, and while it was not so comprehensive in its claims as the Bell patents, it would have been sufficient to afford a monopoly to the Bell company for 17 years longer, the original Bell patent expiring in 1893. In view of the fact that much discredit was thrown upon the validity of the Berliner patent by electrical and legal experts, this condition of affairs appeared to be unjust and suit was brought by the United States government against the Bell Telephone Co. to annul the Berliner patent. This suit was at first sustained, but upon appeal was lost.

In view of this decision the Bell Telephone Co. instituted the suit above referred to against the National Telephone Co. at Boston for infringement of its patents, and on February 27, last, the decision was rendered overwhelmingly in favor of the defendants. In the evidence presented it was conclusively shown that the original Berliner application was for an instrument that would not successfully reproduce speech, and that the patent as issued included features not intended or thought of at the time when the application was made, one of them being the constant-contact feature of present transmitters. The patent as issued was anticipated by patents of both Bell and Edison.

It is generally admitted that the position taken by Judge Brown, who tried the case, is so tenable that it will never be overruled, and that it will inspire confidence among investors in the manufacture of apparatus and in companies independent of the Bell Telephone Co. While the latter still holds upward of 2,000 patents and has a grip on the telephone business of the country such as has seldom, if ever, been obtained by one company in any other line of business, there are no fundamental patents to interfere and apparently no reasons why the independents should not gradually grow in strength and make competition more of a reality than has been possible in the past.

LATHE FOR TURNING LARGE GRANITE COLUMNS.

AN INTERESTING STONE-WORKING MACHINE OF UNUSUAL SIZE.

A structure now building in New York City which, when finished, will undoubtedly be an object of general wonder and interest to visitors, is the cathedral of St. John the Divine, on Morningside Heights. It has been building several years, and many more must elapse before it is completed, as the architects' plans call for a construction that in magnitude nearly rivals the stupendous work found in many of the ancient ruins of the Old World.

Forming a semi-circle back of the choir there will be eight granite columns, 6 feet in diameter, 54 feet high and each weighing nearly 140 tons. Each column is a monolithic cylinder turned and polished to glasslike smoothness, and is formed from granite remarkable for its great strength and freedom from checks and seams. Besides the large columns mentioned many more will be required, in the construction of the cathedral, of a size which would ordinarily command attention, but which are of minor importance in comparison with their giant brothers. All of the columns are turned and polished at the quarries from whence the granite is obtained at Vinalhaven, Me.

To turn and polish these columns, especially the larger ones, a lathe was required of strength and dimensions which undoubtedly exceed anything ever before attempted in stone turning and polishing machinery. To meet the requirements a monster lathe was designed by E. R. Cheney and H. A. Spiller for the Bodwell Granite Co., Vinalhaven, Me., and it was built at the works of the Philadelphia Roll & Machine Co., Philadelphia, Pa. Its construction was begun in December, 1899, and it was delivered at the quarries in May, 1900.

The lathe has a capacity of 60 feet in length, and will swing a maximum diameter of 6 feet 6 inches. It weighs complete about 135 tons, and has a total length of nearly 86 feet. The granite columns are not swung on centers, but are carried in immense hollow chucks as is apparent from the acompanying illustrations. The headstock and tailstock are of the same design, each having a hollow chuck mounted on a steel spindle which rotates in babbitted bearings. Of

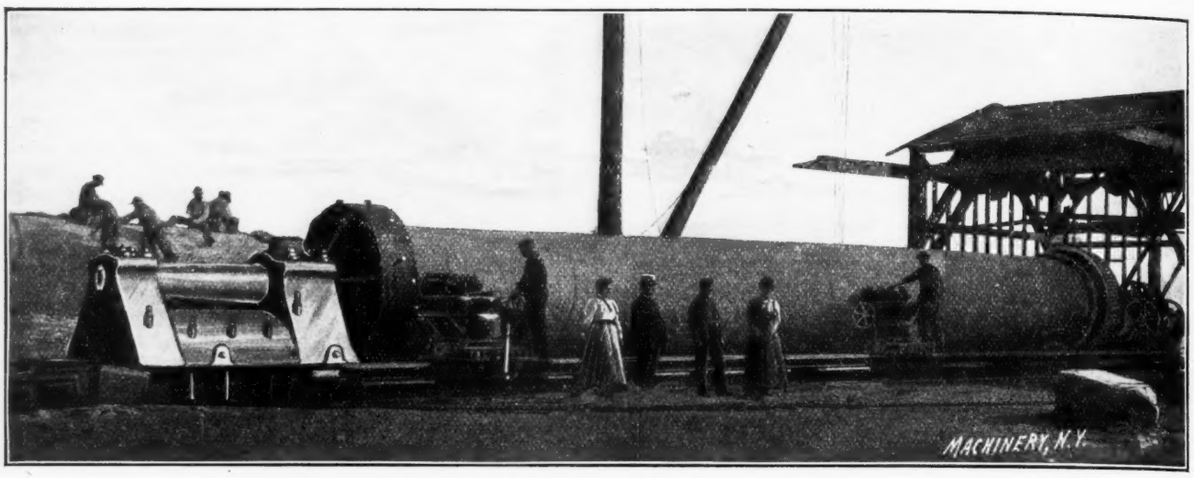


Fig. 1. Tailstock end of Granite Lathe at Vinalhaven, Me. Stone being turned is fifty-four feet long and six feet in diameter. Weight when finished about 140 tons. Chipping off corners of another column in background.

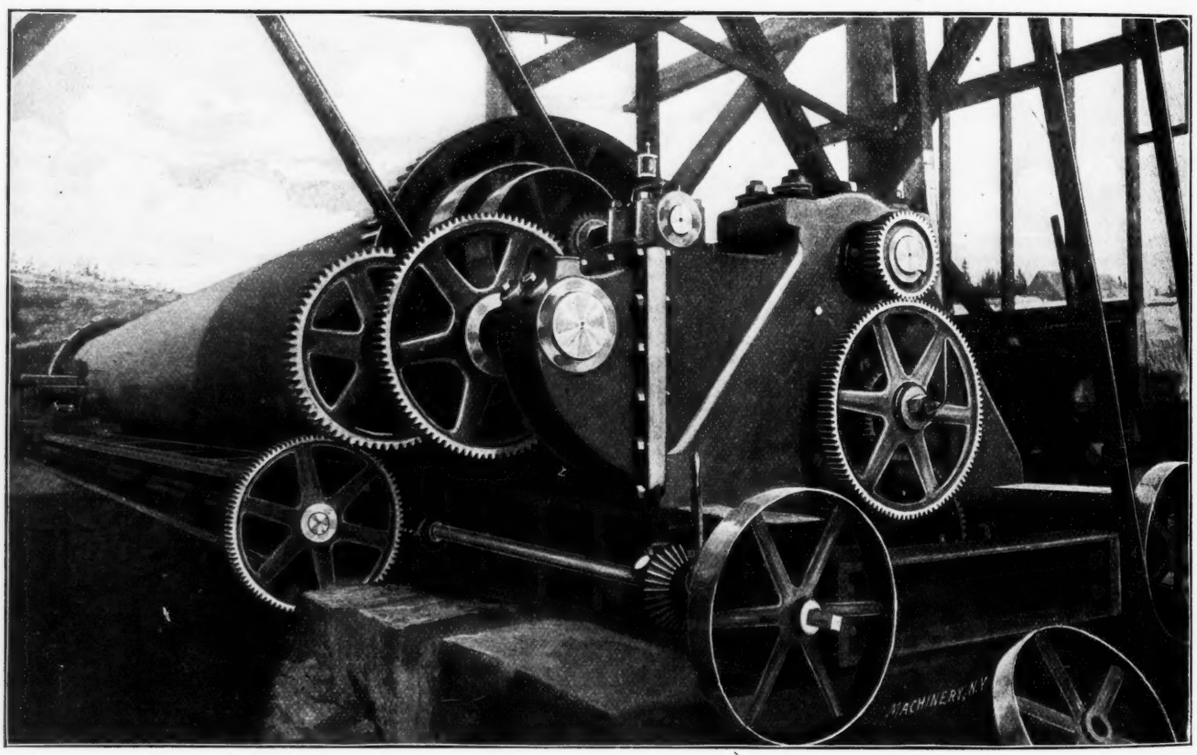


Fig. 2. Headstock end of Granite Lathe. Lathe complete weighs 135 tons. Swings six feet six inches, and is sixty feet between centers. Total length, eighty-six feet. Four carriages and eight rotary cutters used.

course, the tailstock has no driving mechanism, but in other respects it is a duplicate of the headstock. The hollow chucks are castings made from open hearth steel, and each is provided with 24 steel set-screws for holding the stone in position. The screws abut against steel and cast iron blocks, which fulfill the office of ordinary chuck jaws. The steel blocks are 1¾ inches high and 5 inches square, and the cast iron blocks are 8½ inches high and 5 inches square. The steel set-screws are 2 inches in diameter and 9 inches long, and have an adjustment of about 4 inches.

levers a longitudinal movement which brings them out from behind a ledge or catch on the carriage when they may be moved transversely to engage or disengage with the screws. The catch prevents accidental movement of the lever, since to change it from either position, a compound movement is required. Each carriage is mounted on four friction rollers, which carry it about one-hundredth of an inch from the ways and thus give rolling instead of sliding contact.

The interesting feature of the tool carriage, however, is the tools which remove the granite. They are revolving steel

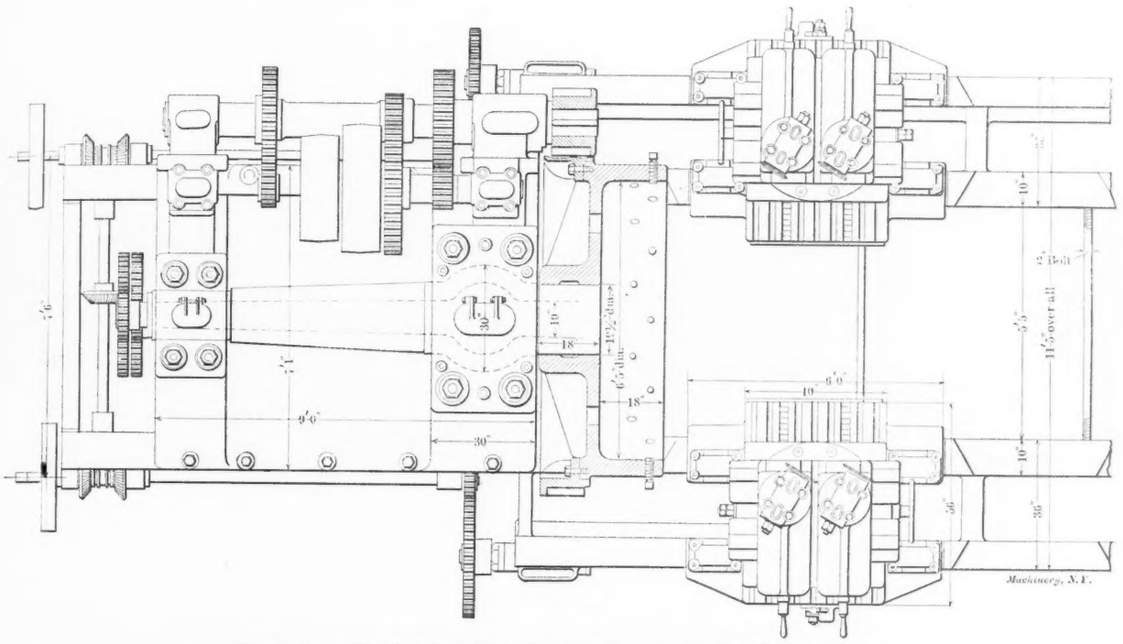


Fig. 3. Plan of Headstock end of Lathe, showing two of the four Tool Carriages.

The bed proper was made in six sections, each 21 feet 6 inches long, three on each side, and tied together by bolts, as shown at *E* in Fig. 4. The headstock and tailstock are mounted on extensions to the bed, which are each in two pieces, thus making ten composite parts of the whole bed. Its width over all is 11 feet 6 inches, and the total length, as already mentioned, is nearly 86 feet. There are four tool carriages, each

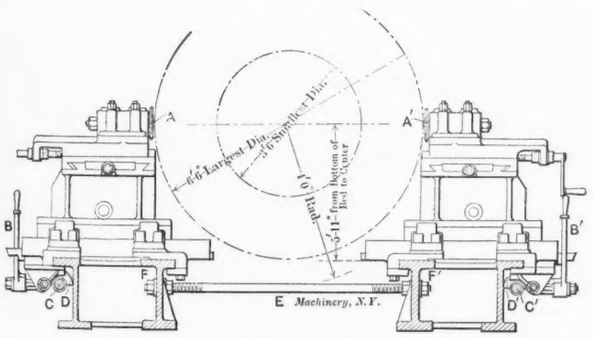


Fig 4. Section through Bed showing Carriages and Disk Tools.

carrying two tools, making eight in all. The carriages are fed longitudinally by two lead-screws, one on each side of the lathe. The lead-screws are each 66 feet 3½ inches long and made in one piece. The threaded portions are 58 feet 6 inches long. The diameter of the screws is 4 inches, and the pitch of the thread is 1 inch. The construction and transportation of the screws was one of the most difficult features met in building the machine. The tool carriages are driven directly by the engagement of nuts with the lead-screws, there being no rack and pinion feed as is usual on metal-working lathes. The feed nuts are half nuts only, and engage with the upper part of the screws. The screws are supported throughout their length by ledges or troughs at intervals. The half nuts are connected to rocking levers *B* and *B'* in Fig. 4, which enable them to be engaged and disengaged by transverse movement of the latter. It is necessary, however, to give the disks 10 inches in diameter mounted in suitable bearings and held approximately to the angle indicated in the plan view, Fig. 3. Each tool has an independent angular adjustment on the carriage as well as a transverse adjustment.

A section of a disk and its bearing is shown in Fig. 5, which shows the steel disk at *A* held to its spindle *C* by the through bolt *B*. The disks are driven by engagement with the revolving stone and operate by a wedging action, or more properly by a species of "spalling off." Each cutter will reduce the diameter of a stone 3 inches at a pass, so the eight cutters would reduce the diameter of a column 2 feet at one pass of the four carriages if need be, although such reduction is not required in practice.

The outlines of the spindles are shown by the full and dotted lines in Fig. 3. Each spindle is alike, each having a plain cylindrical bearing at its outer end and a spherical bearing at the chuck end. The spherical bearing is 30 inches in diameter and is babbitted with the best metal obtainable for the purpose. The castings for the headstock and tailstock are made with longitudinal and transverse webs in the boxes which formed shallow pockets for the babbitt metal. When

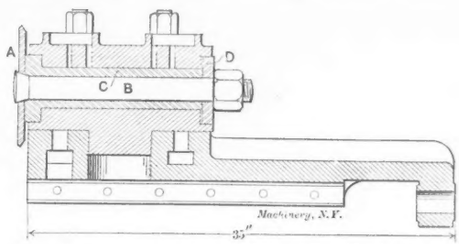


Fig. 5. Section of Disk and Slide for Removing Granite.

the babbitt was poured it partially covered the webs over, but grooves were cut down to their tops so that each journal has a system of oil grooves crossing each other, and the babbitt metal is held in pockets that prevent its being squeezed out of shape by the immense weight carried on the journals when turning a column. Since a column in the rough may

easily weigh 240 tons and the weight must be carried on the journals, as there is no central support given the stone, it is evident that there needed to be provided a durable construction for these important parts.

For driving the headstock, gearing is provided which has a range of 1 to 23 to 1 to 112 turns of the two-speed cone pulley. A fifty horse power engine is required for driving the machine when turning a stone.

The lathe as a whole is a remarkable piece of work for the shop building it. The works of the Philadelphia Roll & Machine Co. were not designed for such extremely large work, but they handled it in a very creditable manner. The lathe was erected before shipment and nearly filled the whole length of the machine shop. So high were the faceplates that the traveling crane could not be used, as the operator's cage would not clear. It was erected at Vinalhaven under the supervision of Mr. J. W. Bourn, the foreman of the machine shop, who gave the writer some interesting points regarding the quarries and character of the island on which they are located.

The lathe was erected on a granite foundation which was so smoothly finished on top that there was no need of any filling between the bed and its granite base. It is located about one-fourth of a mile below the quarries and about 500 feet from the water. The columns are quarried out in square cross section and are transported to the lathe on steel rollers, being drawn by steel cables and a hoisting engine, and held back by cables to prevent "running away." The corners are chipped off before rolling into the lathe, and when the columns are finished they are rolled out at the opposite side and to the water's edge, where they are loaded on special scows built for carrying two of the largest columns.

Fox Island on which the quarries of the Bodwell Granite Co. are located is off the coast of Rockland, Me., and is practically a huge granite ledge 9 miles long and 2 miles wide. The quarry from which the columns were obtained is remarkable for the production of granite of great transverse strength and freedom from seams, checks and flaws which would be fatal to columns of such large dimensions. It is thought to be about the only quarry in the United States that could produce monoliths of the size required for the cathedral columns. The quarrying of such huge masses is an operation requiring the greatest care, as a false movement would readily ruin the work of weeks. The quarrying is accomplished entirely by drilling and wedging, no blasting being possible for the reason that the stone would be shattered and flaws produced that would affect the integrity of the finished work. For the same reason quarrying cannot be carried on during cold weather. The holes are drilled from the top and side of the mass to be loosened, and in the direction of the grain of the granite. One and about the only defect likely to be encountered is a black knot or a "growing fast" which spoils a stone. A block of granite of the size required for the large columns under consideration represents a labor cost of about $1,500 when it has been transported to the lathe. The turning and polishing of each one requires about six weeks' work.

* * *

The electrician Gramme, the inventor of the dynamo which bears his name, died in Bois Colombes, near Paris, on January 20.

Zenobe Gramme was born in a little town near Liege, Belgium, of poor parents, and when still very young he became a joiner. Later he went to Paris, where he began his researches, using his kitchen as a laboratory. Owing to perseverance and hard work he finally became successful, and in 1869 took out his first patent. From that on he labored assiduously and added many improvements to his original inventions. At the Centennial exhibition, Philadelphia, he was classed among the famous electricians of the world. A few years later he was awarded, in France, a prize of 50,000 francs.

Gramme was not, as will be noted from the foregoing, a Frenchman, but a Belgian. He left his native land, however, when very young, and it was in France that he made the great scientific discoveries that brought him fame.

O. M. & CO.—3.

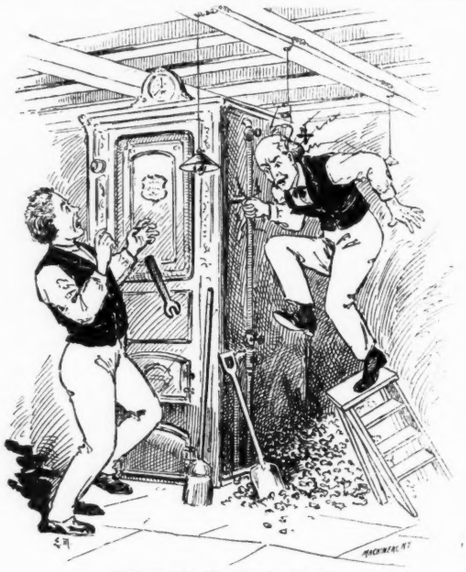
ELECTRIC VS. MECHANICAL DRIVE.

ELMER E. WARNER.

The Old Man, like most practical mechanics of the last generation, was entirely unfamiliar with electrical science. The generation and transmission of this force was entirely too subtle for him. As he expressed it himself: "Young man! I can see steam and smell gas and feel air pressure, but this electricity business is out of my range."

Probably this natural respect was heightened by the injudicious use of an induction coil by a sympathetic friend one day when the O. M.'s rheumatism got the better of him. Also by bringing his ear accidentally into contact with a bare electric wire in the fire-room of the C. Muggins Co. one afternoon.

He had been called in by his old business acquaintance, Mr. M., to give advice about a new and balky injector, and had climbed a step-ladder to trace out the boiler connections. He



"Now, Mr. M., the trouble"—

had just struck it. Straightening up in his favorite attitude when laying down the law, he commenced: "Now, Mr. M., the trouble"——and reached over and grasped the feed-pipe to steady himself. Just what happened the O. M. never exactly knew, but Muggins picked him up off the floor with hurried solicitude, and swore that 220-volt current was guaranteed harmless.

The O. M. at first had a lurking suspicion that the fireman had hit him on the head with a shovel, but the man proved an alibi, and a quarrel was averted.

. . . . . .

It was decided, after some discussion, to install three 60 horse power horizontal water-tube boilers of the latest type. The question of engines and power transmission was on the floor, and the O. M. had issued his pronunciamento.

"Now," he said, illustrating with a piece of chalk, "here's your engine here and here's your tool over there. How are you going to get that power from your engine into that tool? Why, belt and shaft, of course. I don't know much about electricity, but it stands to reason you can't change that power into electricity and back again without more expense and loss than a straight drive. That's a plain proposition, now, ain't it?"

"Well, O. M.," says the Y. M., "it looks straight enough, I'll admit, but looks have fooled smarter men than you and me. Suppose we try and just see how it is. You've been running a shop all your life. How much power does it take to keep this little place turning over?" "About twenty horse." "And how much goes into belting and shafting?". "Don't know." "Well, I do. Got a pocketful of figures from all sorts of plants. Just about half your power goes to turn shafting, belts and loose pulleys, and when you're slack, three-quarters or more goes that way."

"How much coal do you burn a day?" "About three-quarters

of a ton." "At four dollars per ton, that makes three dollars a day. One-half of that for transmission losses makes a dollar and a half or four hundred and fifty dollars a year. But that's only one item. How many shut-downs did you have from broken belt laces, and delays while taking up the belts?" "Don't know." "Well it's pretty hard to figure, but lumping general care, oil, belt renewals, re-babbitting and bushing, delays, etc., I'll bet it's cost you two hundred dollars a year to keep things from coming to a stand-still." "Shouldn't wonder!" "Now, what's all that ceiling furniture worth—countershafting and all? There's about thirty C. S. at fifteen apiece, say, four fifty, plus your main line, jack, and belting, about four hundred; makes eight fifty. Interest at five per cent., forty-two and more a year. That makes nearly seven hundred a year for your transmission expenses. Never found that out before, did you?

"Now, how many men do you work in the shop a year, on the average?" "About twenty-five." "And they average twelve a week, or six hundred a year. That's a labor bill of fifteen thousand a year. Now, what's the transmission losses on them?" "Don't know what you're driving at."

"Well, I'll tell you, O. M. That man operates that tool, doesn't he? Got to get there with his eyes, both hands, and his feet. Tool's a sort of machinery annex to him. Got to get the best possible working combination. Got to reduce the transmission losses here. Glad to save something on the seven hundred, if we can; but got a bigger stake in the fifteen thousand—twenty times as much. Just as soon raise the seven hundred to a thousand, if we can raise the output five hundred.

"The sum and substance of my little sermon is that the first question to decide electrical or mechanical drive is, Which is the best working combination, handiest, most flexible, cleanest, most positive and unfailing? Now you think you've got me, but you haven't. I can show you a combination drilling, tapping, and milling machine, with five independent electric heads working at five different points on the same large casting, at the same time, on different operations. Cost cut forty per cent. Total time on machining cut five hundred per cent. And no conceivable combination of gearing would distribute this power through the range of movement possessed by those five independent heads. Flexible, yet positive, compact, and simple. But that's a special tool, and a later story.

"Now, I propose to put in a one hundred horse power tandem compound, direct-connected to a one hundred-and-ten volt generator for our motor load. Also a fifty-horse, simple engine direct-connected to a smaller machine for our lighting load, for use in case of breakdown on large engine and for overtime and slack time. Suppose we do a little figuring on the basis of this hundred-horse motor equipment—its interest on investment, on the one hand, against the coal pile on the other. Let's try and strike a balance on the proposition.

INVESTMENT IN DOLLARS.

Direct Drive.

Belting, shafting, and countershafting	$2500
Interest, 5 per cent.	$125
Depreciation, 15 per cent.	375
Excess power, 7 horse power, at 40	280
Total	$780

Electric Drive.

Generator	$1000
Distribution	100
Motors	7000
Total	$8100
Interest, 5 per cent.	$405
Depreciation, 2 per cent.	162
Total	$567
Balance in favor of Electric Drive	$213

"Pretty close, eh, O. M.! Fact is, it's about a tie on direct costs, with a distribution as compact as ours, but indirectly everything is in favor of electric drive.

"We can save on cost of building, have clear head room, lose less time taking up belts, and set tools in any desirable position.

"Will have to standardize as much as possible—that is, stick to best types and fewest sizes. Lathes, for instance, might run 10, 14, 20, 30, and 50-inch swing. Composite designs are coming on the market every day. Better get the right thing, even if we have to pay a little more for it. For first floor distribution, we will drop down behind switchboard on south side of engine room with two insulated cables, and run out about twenty feet to a branch box fused solid; from there we can carry a circuit up each of the three bays on porcelain insulators, tapping off solid and running up through cast brushes to each machine. We can put a door through at the foot of the stairs to fire-room, and dig out a gallery, following up under these runs.

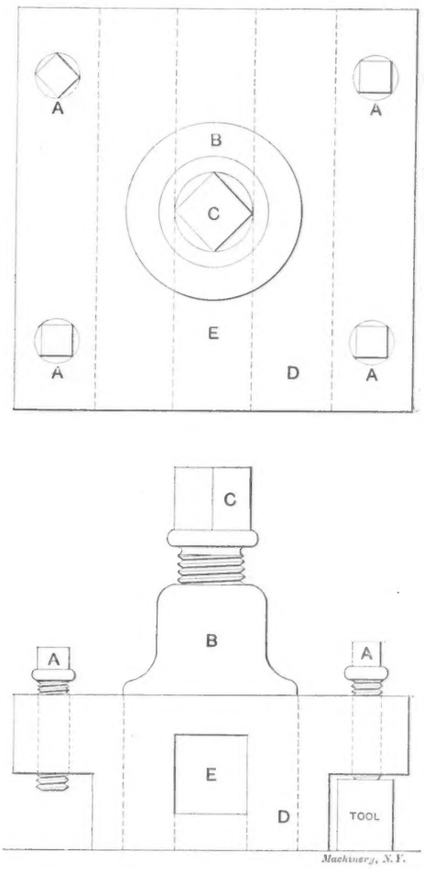
"Now, O. M., we'll have a shop without a hanger, clutch, or belt in sight, and we will get more work out of our tools, too."

"Well!" says the O. M., "you'll get more money out of me, anyway. At this rate, we'll have to put up a trolley for the men, too."

* * *

SIMPLE TOOL BLOCK FOR LATHES.

The accompanying cuts show the plan and front elevation of what is presumably an old device for converting an ordinary tool-post into a tool block with recesses for tools at the sides. It was recently observed on an old roll lathe in the machine shop of the Philadelphia Roll & Machine Company, Philadelphia, Pa., and as it is well liked by those using it, it may be of interest to others.



Plan and Elevation of Tool Block.

It consists of a casting *D* having a square opening cored through it at *E*, and with ledges at the sides. A hole is bored through the center for the regular tool-post, and when in use the casting *D* sets over the post, as shown, with a piece of tool steel through the hole *E* to take the thrust of the tool-post set-screw *C*. In this manner the tool block is firmly held to the cross slide at any desired angle. The set-screws *A A A A* are, of course, for holding the tool, as shown, at the right.

* * *

The chief drawback to the use of aluminum for electrical lines in place of copper is that unless it is very pure it oxidizes and must be protected with some covering.

LETTERS UPON PRACTICAL SUBJECTS.

CUTTING-OFF MACHINE.

Editor MACHINERY:

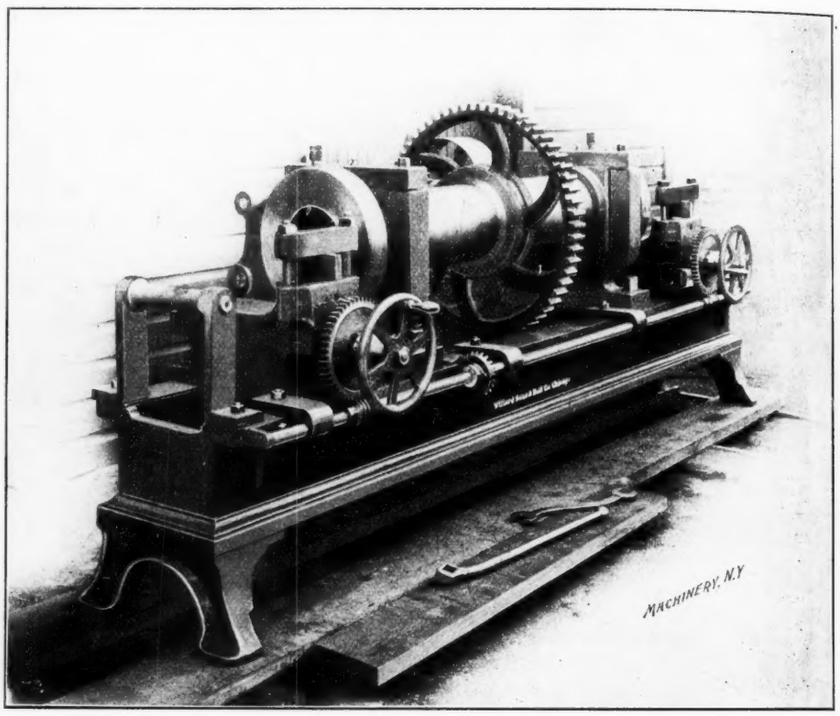
I enclose herewith a photograph of a machine for cutting off railroad axles and similar forgings. I designed this machine and it was built by Willard Sons & Bell Co., Chicago. It was built at comparatively small cost and will cut off from five to six axles of 7″ diameter in one hour, showing a gain of 25 per cent. to 33 per cent. over the old style machine that was in use. The features of the machine are that the shafting or axles are held securely in a hollow spindle that is supported by housings rigidly bolted to the bed plate; and that this spindle is driven by double gearing from the pulley shaft at the rear, the ratio of the gearing being 13 to 1.

The piece to be cut off is held in the hollow spindle by placing a V-shaped piece in the spindle, under the axle, and tightening a set-screw against the top of the axle. These V-shaped pieces are turned on the outside to fit the hollow spindle and are made in thicknesses to suit the diameter of the axle to be cut off. A number of these are kept on hand. In practice a car axle is forged so close to size that different ones will not vary from one another by more than 1-16″ in diameter, so that with the arrangement used the center of the axle will always come practically in the center of the hollow spindle.

The cross feed is driven by a 1½″ belt from a 3-step cone on the pulley shaft at the rear of the machine. This cone is belted to another cone placed on a shaft at the rear and below the pulley shaft. This lower shaft is connected with the feed shaft shown in the photograph on the front of the bed by two pairs of bevel gears and a shaft running across from the rear to the front. The front feed shaft drives the cut-off slides through the worms and wormwheels, as indicated. The feed for each tool can be thrown out or in by sliding the handwheels on their shafts, thus engaging the hubs on the handwheels with pins driven in the wormwheels. Special tool holders are provided having a yoke that can be clamped securely upon the tool. The carriages, as made for this machine, are not movable as the machine is intended mainly for cutting off car axles at each end to a uniform length. The machine may be built, however, so that the positions of the cutting-off tools can be changed, by sliding the carriages along the beds.

AD. R. SODERBECK.

So. Chicago, Ill.



Inexpensive Cutting-off Machine.

* * *

CHANGE GEARS—THREAD TOOLS—COMPOUND RESTS—THE METRIC SYSTEM.

Editor MACHINERY:

In the February issue of MACHINERY, in the "How and Why" department, the table of change gears given in answer to W. H. H. can be used to cut a number of fractional threads. If the correspondent wanted to cut a U. S. standard thread for 1⅝″ diameter, 5½ threads per inch would be required. The gears given for 11 threads per inch (which is twice 5½) are 16 on the stud and 44 on the lead screw. By using the same screw gear as for 11 threads and doubling the number of teeth in the stud gear we would cut a screw twice as coarse, or 5½ per inch; $2 \times 16 = 32$, so 32 on the stud and 44 on the screw are the gears required.

In many instances of fractional threads, and sometimes whole numbers—the gears for which are not given in the index plate of the lathe—the required gears can be most conveniently found by this method, if the fraction is a subdivision of any number given on the index plate. As another example, suppose it is required to cut a U. S. standard thread of 3½″ diameter. The threads required would be 3¼ per inch. The gears given in the table for 13 threads per inch are 16 on stud and 52 on the screw. Now as 3¼ is contained in 13 four times, multiplying the stud gear (16) by 4 gives 64; and 64 on the stud and 52 on the screw are the gears required.

Thread tools, and even those with inserted cutters, usually have no top rake. For brass work this would be correct, but for iron or steel, if the point of the tool slants upward, much more work can be done, as the chips are cut from the stock instead of being torn out. If the lathe has a compound rest it will save time in cutting screws with a V thread to set the rest at an angle of 30° as heavier cuts can be taken, the tool doing most of the cutting on one side.

If more lathes were equipped with compound rests their usefulness would be increased, as some jobs could be done more conveniently than without, such as turning bevel gear blanks, boring taper holes, etc.

I have been reading the interesting articles on the metric system, which have appeared in MACHINERY, both for and against it. It has been stated by some who ought to know that if we had this system instead of our present one it would save two years of our school life. If this were true most of us, especially workingmen, would like to have it adopted for obvious reasons.

The chief opposition to it probably comes from the mechanical engineers, and their objections may be because of the great expense and labor necessary in the standards for use in measurements; and, moreover, books on mechanical engineering would need to be revised. The argument that the metric system would cause errors because it is a system of decimals will not stand. The system of U. S. money is a decimal one, but that does not prevent us from obtaining accurate results; quite the other way. But we could not conveniently have two systems of measurement at the same time, as it would make considerable labor to express equivalent sizes.

If the metric system was generally adopted, and we found it inconvenient to get along without our inch with its subdivisions and multiples, why not adopt another inch, which is

a subdivision of the meter. Twenty-five millimeters equal .98425", and if 25 mm were adopted for a new inch, we could call it a metric inch. It would be about 1-64" smaller than our present inch.

This could be divided in 64ths, 32ds, 16ths and 8ths, as at present. The micrometer calipers and the verniers could be graduated as at present, the graduations, of course, being a shade smaller. Drawings could be made to scale as at present.

The system of diametral pitches for gears could be retained as it now is, the inch probably being not enough smaller to make any great difference in the strength of gear teeth. Of course, the change would make a greater difference in a foot (about 3-16") and a still greater difference in a yard, or about 9-16". A cubic inch which now contains 16.386 cubic centimeters would have but 15.625 cubic centimeters.

While the systems of linear measurements between England and the United States are alike, others are not. A U. S. bushel is .96946 of a British bushel. In liquid measure the liter is a cube of 1-10 meter, or 1 cubic decimeter; one side of this cube contains 3.937 English inches, or 4 inches of the shortened kind suggested. This contains 2.113 American pints, of 1.76 English pints. The deciliter is 1-10 of the liter, and the decaliter is 10 liters. The unit of weight is the gramme, which is 1-1000 of the liter, or 1 cubic centimeter; one side of which is 10 millimeters in length, filled with pure water at 39° F. in a vacuum. This is equal to 15.43 grains Troy. The decagramme is 10 grammes, and the hectogramme is 10 decagrammes. In making calculations we multiply or divide by 10 by shifting the decimal point.

East Providence, R. I. JOHN T. GIDDINGS.

* * *

ELECTRICALLY DRIVEN LATHE.

Editor MACHINERY:

Great as have been the increase in the use of electricity as motive power, but little progress has been made in its application to machine tools of ordinary size. The general conservatism on the part of machine builders has been justified by the greatly-increased cost, for which there seemed no evident compensation in steam saving or conveniences. A careful study of the problem leads the writer to believe that due weight has not been given to these secondary considerations, and that in connection with larger machinery, cranes etc., and with a complete and composite design the balance will be found to favor electric drive for machines taking one horse power and under. As a suggestion of a satisfactory combination the following sketch of a 16" to 20" engine lathe is presented.

This tool has a large box leg under the head, and there is an oil and chip pan under the bed. Any ordinary round type, four-pole, one-horse motor can be purchased in the open market and mounted in the tool by the manufacturer. The sketch, however, indicates that the armature bearings are cast and fitted to the lathe leg; as they probably would be if the motor were built by the maker of the lathe.

Current for this tool is preferably brought up through the floor by two insulated conductors carried through a cast flanged bush under the leg. One leg of circuit after passing through a fuse block is carried directly to the field and armature connections on one side of the motor. The other is plugged through the bed into the lower of three insulated contact strips mounted on the front of the lathe, just below the rack.

Spring contact plungers take off the current to the controller set in the right-hand end of the carriage apron, and return it to the field and armature through the intermediate and top contact strips respectively in the usual method of connection. For lathes not more than six or perhaps eight feet in length a simpler arrangement would be to mount the controller on the front of the bed under the head.

The commutator, as may be noted, is readily accessible through the large door at the end of the leg, and by loosening one bolt at *A* the end bearing and armature may be drawn out of the machine. The general arrangement of gearing probably needs but little explanation, the moving parts of the motor being shown simply for distinction. From a pinion on the motor shaft we reduce to a large gear and bank of gears on the same shaft. Another similar bank of gears over them takes the place of the regular cone.

This upper bank of gears is driven approximately at the various speeds given through a steel or rawhide pinion mounted on the end of a lever and sliding along an inclined swinging shaft that follows the opening between the banks

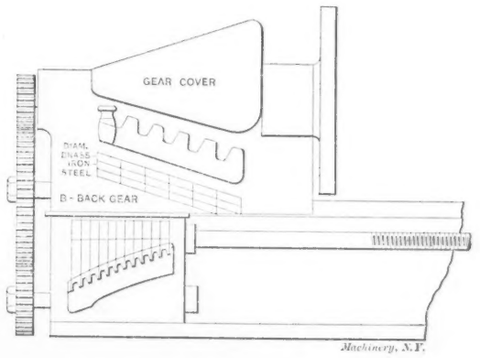


Fig. 2. Outline of Head and Feed Arrangement.

of gears. It will not mesh in the upper set until in line with a given gear, when the lever can be pushed up into a notch in front of the casing. A spring stop pin holds it in place. This tool has a regular bank of feed gears and reverse for carriage, not shown. The tool itself does not reverse with this feed control. Such a small proportion of work necessitates reversing the rotation of spindle that but one lathe in ten ordinarily needs to be arranged for it. Where necessary it should be accomplished by friction clutches on the live spindle, as the motor itself cannot be reversed quickly enough.

Deducting the value of counter-shaft and belt to the cone, the net extra cost of this drive should not exceed $100 in lots of ten or more.

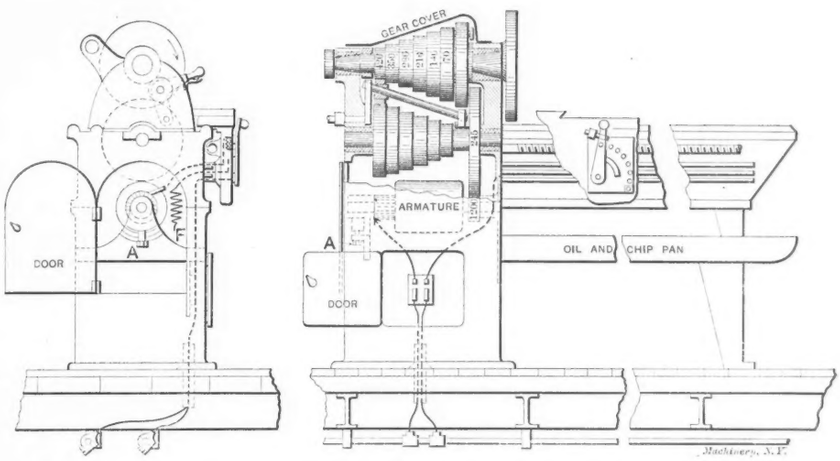


Fig. 1. Arrangement of Motors, Gears and Controller

Many experiments show the maximum power required in turning to be but little over one-half horse power, but polishing at high speeds would tax the motor fully. Extensive tests of various plants also indicate a saving of from five to ten per cent in steam under the average conditions under which this tool would be used. Cataloguing its advantages we have:

First—No power consumed when the tool is not in use, and no wear, as in the case of belts, clutches and counter-shafts.

Second—No time wasted in relacing and taking up belts. The depreciation is far less with enclosed self-oiling bearings and well cut gears. Reliable and positive.

Third—Clear head room for light cranes; unbroken light; no overhead clutches slinging oil, or dripping bearings.

Fourth—Superior facility in handling. No belt shifter required. Control always under the operator's hand at the working point.

Fifth—Superior flexibility. The tool can be set anywhere and at any angle; can be connected for one-tenth the cost of putting up counter-shaft and belting. The interest on this extra $100 is only $5 a year.

Are not all these advantages worth a great deal more?

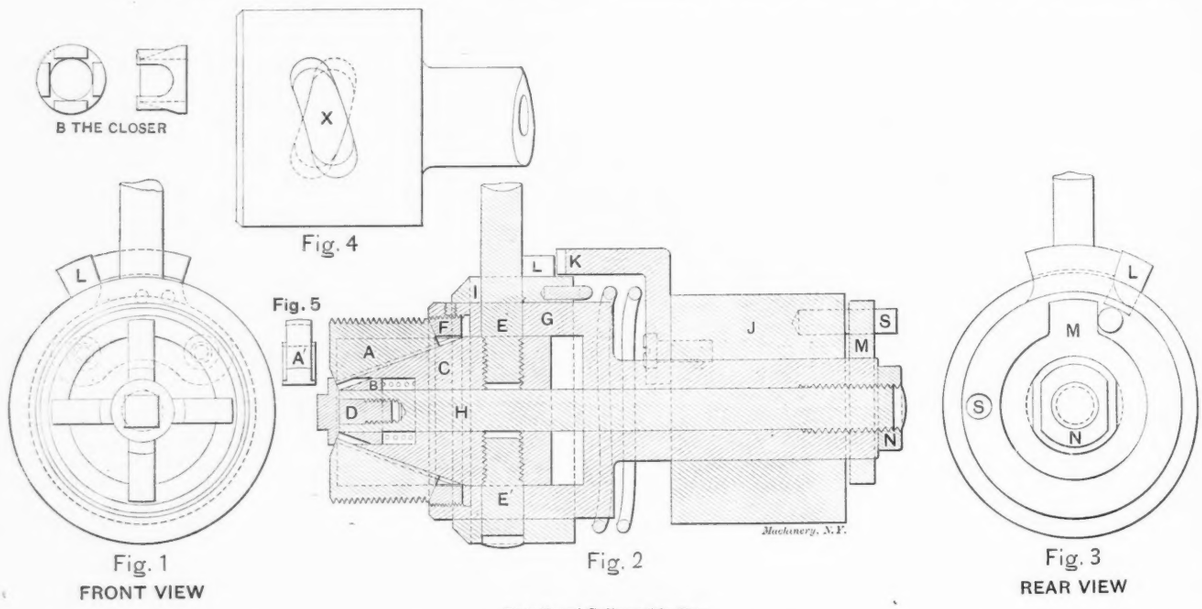
ELMER E. WARNER.

* * *

COLLAPSIBLE TAP.

Editor MACHINERY:

The collapsible tap, shown in Figs. 1, 2 and 3, was designed and made in the electrical shop of the Equipment Department, Navy Yard, N. Y., and was made for the purpose of threading the tubes that render the passage of electric conduit pipes water tight in their course from one deck of a ship to another, or through the various bulkheads and water-tight compartments into which a ship is divided. This work is done in the Navy Yard shop on a Jones & Lamson flat turret lathe, and consequently the tap was made to fit in a tool holder of that machine. The tap has been used for 18 months on composition castings of a good grade generally, and it is believed that the objects sought in its construction have been attained. It was desired to obtain first a tool that would permit adjustment for wear and also allow for the variance in the working of different lots of castings, since it had been found that a solid tap would vary greatly in its work according to whether the metal was hard or soft. The advantage of collapsibility needs no comment, since it effects a saving of nearly 50 per cent of the cost of the operation, to say nothing about the saving of the power and general wear of the machine or of the cutting qualities of the tap itself.



Details of Collapsible Tap.

Economy in repairs was a feature to which much thought was given. This condition has been realized, for each of the three sizes of taps has been used on many thousands of pieces, and, except for the time taken for adjusting, no money has been spent on repairs, and the taps are in perfect working condition. It should be understood that the device is practicable only where many thousands of pieces are to be made, since the first cost of such a tool is equal to the cost of six or eight solid taps of like size.

The drawings are those of a tap 2¾″ diameter, 12 threads per inch, and the thread of this tap, instead of being cut in the lathe, was milled on in a milling machine. In Fig. 2 the tap is represented as being on the point of collapsing. The operation is as follows: The chasers *A A'*, Figs. 2 and 5, work in the inclined T-slots of the plunger, butting against the adjusting ring *F* at one end and against the head of the screw *D* at the other end. The angle of the T-slot is 20° and the angles of the ends of the chasers 70°. It follows that, if the plunger *C* is moved backward horizontally, the chaser must move downward at an angle of 20° from the perpendicular. The plunger is free to move and turn in the body *G* of the tap, the movement being limited by the guide studs *E E'*. These studs, one of which is lengthened to act as a handle for setting the tap, pass through the closing ring *I* and also through the spirally-inclined slots *X*, Fig. 4, and are screwed into the plunger. The closing ring *I* serves the double purpose of covering the cam slots *X* in the body and carrying the hardened stop pin *L*, Figs. 1 and 2. Attached to ring *I* is a coiled spring, one end of which enters a hole in fixed stop *K*. The purpose of this spring is to carry back the plunger until the studs strike in the slots.

The striker *M*, Fig. 3, is to limit the movement of the body. After setting, the tool is brought to the work and entered, and when the proper depth is reached, the stop pin *L* feeds off the fixed stop *K*, the work carrying the tap around until the striker *M* reaches the pin *S*. At this point, if the chasers have not previously let go, they now must, and the spring carries the plunger back until it has reached its limits. The function of the closer *B* is to keep out the chips that would otherwise prevent the use of the tap. The adjustment is made by unlocking the spindle *H* and turning forward, then turning the ring *F* in or out, as may be desired, then turning back the spindle *H* until the screw head *D* just touches the chasers and lock again at N.

Brooklyn, N. Y. J. R. GORDON.

* * *

A WORKMAN OF ABILITY.

Editor MACHINERY:

In our shop we have a decided novelty in a man who got caught on a line shaft revolving 180 revolutions per minute, and when the engine was stopped, was cut loose with the only injury of being almost scared to death. The man was tightening a hanger, when his blouse, which hung loose, was caught by the shaft. This caused him to drop a wrench and thus attract the attention of a machinist nearby, who ran quickly to the engine-room, which was fortunately nearby. What saved the man from death was that the shaft was smooth where he was caught and allowed his clothes to slip after all the slack was drawn up. He held onto the ceiling as long as he could, then called for help. As he let go his hold he ducked his head and went around three times, then caught hold again and stopped about a few seconds, when he was forced to let go again and went around about three times more. Then two comrades caught his legs and held him a few more seconds, but were forced to let him go. Just at

this moment the engine slowed down, however, stopping very short. Then they caught him and the danger was over. His escape was considered very remarkable. To give the shop's name would be likely to result in a visit from the factory inspector, who would probably want all the setscrews taken out of everything, and the rest boxed up, or else perhaps a big tip.

NOVE MAC.

* * *

REAMER PRACTICE.

Editor MACHINERY:

In reply to your inquiry about our experience in the making and using of reamers, I am glad to supply you with the following particulars:

The only reamer we use that is out of the ordinary is a taper reamer made with only three blades. These are cut as deep as the strength of the stock will permit and have very little clearance, which is obtained by grinding the blades convex—not flat or hollow. The reamer is used where a considerable amount of metal is to be removed. For instance, we would bore a hole of the right size for the small end of the reamer and then move it up so that it would cut a length anywhere from three to six inches, feeding very rapidly. We have bored thousands of holes with this style of reamer, getting the best results we ever obtained, with the least trouble and in the quickest time.

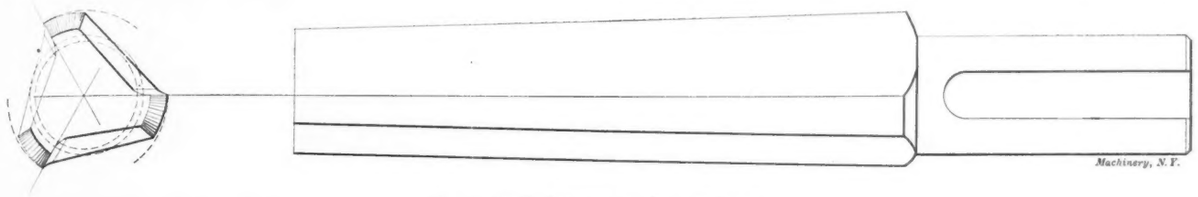


Fig. 1. Taper Reamer with Three Blades.

Many reamers are made and are in use that are known as "home-made;" that is, made by the parties themselves. We have found a great mistake in such reamers. It often occurs that the flutes are cut too shallow and the spacing is entirely too close; that they are evenly spaced and very often have an even number of teeth, all of which is likely to cause chattering and breaking of taper reamers. An evenly spaced reamer will begin to chatter the moment the cutting edge refuses to cut, especially when cutting steel and when evenly spaced. One blade will jump into the space or chatter mark made by the blade in advance of it. Another serious fault with any reamer, either straight or taper, is too much clearance. This will invariably cause a reamer to chatter.

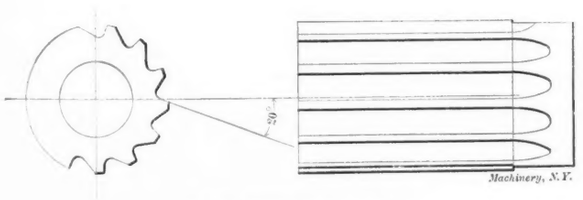


Fig. 2. Reamer for Brass.

As to reamers for brass, we never make them oversize, and we always make the blade of a reamer for brass the same as we would grind a tool for cutting brass; namely, instead of using a radial line of the center as in other cutting tools, we throw the cutting edge of the blade off from the center at an angle of at least 20 degrees out of the radial line. Thus, in turning brass, if you had a tool that was ground straight and mounted it in the tool post exactly at the center of the work you would find that the tool would chatter. Take the same tool and grind it on the top to an angle as above described and toward the under side of the blade, and it would cut quite freely and without any chattering. At all times, however, it is necessary to keep the cutting edge of the reamer for brass extremely sharp, because the very moment the cutting edge is dull it will begin to bind and scream sufficiently loud to drive you out of the shop. Reamers for reaming brass require twice or three times the attention in keeping to a sharp edge that other reamers require.

For hand reaming we never leave to exceed 3-1000 in any material, and all our machine reaming is done by a reamer with very much coarser blades than the ordinary commercial reamer. They are made so that they may be ground on the points, are fed rapidly, and the tool used in advance of them leaves in no case less than 1-32 and often as much as 1-16.

Cincinnati, O. WM. LODGE,
Lodge & Shipley Machine Tool Co.

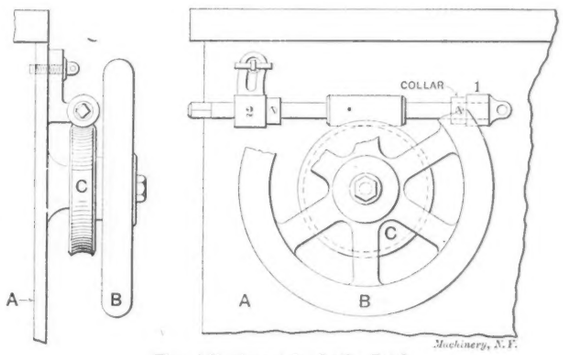
* * *

FINE LATHE FEED FOR USE IN FACING.

Editor MACHINERY:

In the manipulation of lathes of the larger sizes, from 18" and upward, more or less difficulty is experienced in moving or adjusting the carriage to take a finishing chip or to work down very close to a size or fit. This is, however, sometimes accomplished by locking in the feed and moving the feed rod by hand; sometimes also by working the compound rest, and, lastly, by sundry thumps and poundings on the hand wheel and other parts, all of which ways are unsatisfactory. The little attachment shown in the illustration greatly overcomes these difficulties, and is easily made and fastened to the apron. It is not necessary to use the exact design shown in the sketch, as lathe aprons vary, and this can be put on in almost any position that will be most convenient.

The idea of the attachment is to enable one to give the hand wheel by which the carriage is fed longitudinally a very slow and positive movement. The device consists of a double-threaded worm supported by bearings 1 and 2, which are attached to the apron of the carriage. Bearing No. 1 swings on a stud, and No. 2 is slotted to allow the worm to be placed either in or out of mesh with its wormwheel as desired. The wormwheel is attached to the hand wheel shaft,



Fine Adjustment for Lathe Feed.

or if there is not room for this it can be bolted to the hand wheel itself. When the worm is in mesh it will give the carriage the requisite slow motion by simply turning the worm shaft by means of a wrench fitted to the squared end of the shaft. The worm may be triple or quadruple threaded if necessary to secure a suitable feed for the carriage. The slotted bearing for the worm shaft may either be clamped by a thumb screw, as shown, or held in position by a spring latch.

S. WRENCH.

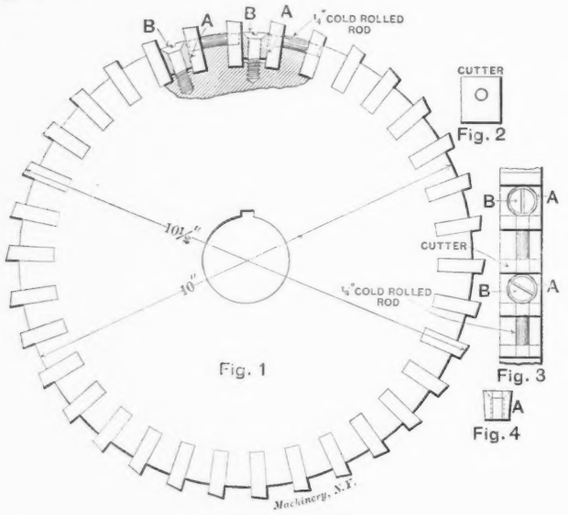
* * *

INSERTED TEETH MILLING CUTTER.

Editor MACHINERY:

The milling cutter shown in the accompanying sketches was made for milling slots 4" deep and 57-64" wide in cast iron columns having a diameter of from 3" to 4". The teeth were made from flat steel 5-16" thick and 1" wide, and were 34 in number. They were held in place by 17 eight-sided taper bushings held down by No. 18 machine screws. The bushings were turned ⅝" in diameter and ⅝" long, and were

milled eight-sided to allow a little play in the holes drilled in the body of the cutter and also to give a flat bearing against the sides of the cutters. The ⅝" holes cut into the tooth slots about 1-32", as shown in Fig. 3, which is a view looking at the edge of the mill. As there was considerable side pressure on the teeth, it was necessary to provide means for resisting it. A groove ¼" wide and ¼" deep was turned in the periphery of the blank, and ¼" holes were drilled in all the cutters, as shown in Fig. 2. As the teeth were assembled in place, short sections of ¼" cold-rolled rod were inserted in the holes in the cutters, as shown in the section part of Fig. 1.



Details of Cutter.

It was necessary to drive the short sections of rod in as the teeth were placed in position, driving each piece through two teeth. It is impossible to take out the teeth without first unscrewing the screws *B* and removing the bushings *A*, and then driving out the sections of rod holding the teeth. The teeth are held in on account of their angular position when the rods are in place.

The teeth were all set in the casting ¾", and were filled up only on the face side to remove the scale. An index head was used when drilling the holes for the bushings and screws. The cutter when finished worked to perfection.

Dubuque, Ia. E. J. B.

* * *

"SPRING MEDICINE" (NOT PATENTED).

Editor MACHINERY:

The other day I noticed that a friend of mine, whom we call John, was in trouble. He was shifting uneasily from one foot to the other, and the agonized expression on his face deepened as he gazed at a skinned finger which he was gingerly holding at arm's length. Drawn by that invisible chord of

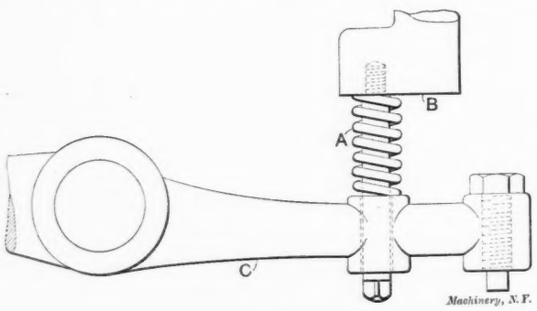


Fig. 1.

sympathy, which in this vale of tears brings us fellow-sufferers together in times of distress, I made my way over to offer him comfort and advice.

He was in sad need of both. In the machine which he was erecting there were quite a number of stiff springs to be placed in the position shown in Fig. 1. As lever *C* has a very short travel the space was too confined to enable one to work to advantage. He had managed to get one spring into position by dint of much perseverance, and with the loss of some skin and of that naturally sweet temper which was one of John's chief charms; but discouragement and woe were now plainly visible on his face.

Two heads are better than one, they say; yet it was not until the third intellect in the possession of John's boss arrived, that new light was shed upon the problem. The scheme which he hatched out is shown in Fig. 2. *D* is a rod loosely fitting the hole in the spring. The distance between the two stout pins, *E* and *F* is a little less than the length of the com-

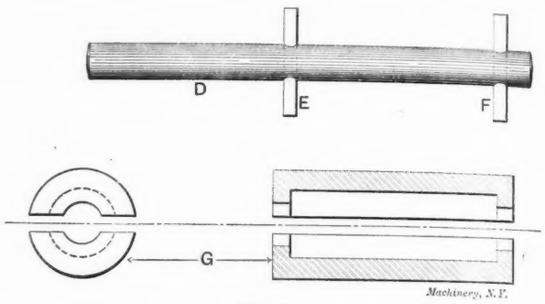


Fig. 2.

pressed spring. *E* fits loosely, while *F* is driven in tightly. *G* was made from a piece of scrap, having through it a hole which was a free fit on rod *D*. It was recessed, as shown, to a larger diameter, and split in two lengthwise.

In operation an arbor press was used to compress the spring on the rod, after which the loose pin *E* was put in place to retain it. The split halves of bushing *G* were now placed about it and held together by a hand clamp, and pin *E* removed. The spring was now held securely in position in the recess in *G* and could be placed in position in the machine and there released.

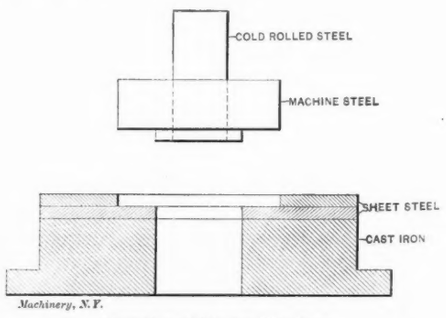
After John had tried this scheme, and done up his finger in a rag wet with alcohol, the usual placid, peaceful look gradually returned to his face, and he was soon working with his customary calmness and deliberation. R. E. F.

* * *

DIE FOR CUTTING WASHERS.

Editor MACHINERY:

We had about 200 washers, 2¼" diameter, 1½" hole, 1-16" thick, to cut from roofing felt recently, and for the job we made a plate and plunger for cutting the hole and blanking the washer at one operation with a single plunger. The plate was made, as shown by sketch, from two pieces of sheet cast steel about the thickness of the stock to be cut. They were screwed and doweled to a cast iron block, which in this case



Punch and Die for Washers.

was a broken die. (I got my idea of using the sheet steel from a previous number of MACHINERY.) The plunger was made from a piece of machinery steel with a piece of ¾" cold rolled steel driven in for a shank, to save turning down.

It is generally believed that it is impractical to cut pieces in this manner on account of the drawing of the stock over the edge of the larger plate while cutting the center blank, but these washers came out very clean, and I don't see any reason why thin metal could not be cut in the same manner. Of course, the steps on the plunger must not be any longer than is absolutely necessary.

Providence, R. I. W. T. SHERMAN.

SQUAREOLOGY: OR, HOW TO PRODUCE A CORRECT SQUARE.

Editor MACHINERY:

It has been claimed that to produce a correct try square is an extremely difficult job. Oftentimes that opinion has its foundation in the comparison of many commercial squares with one another. Most likely none of the lot so examined are proper tools as test squares. In the case of some workmen it is no wonder that their squares are not square, from the fact that their association is with files and other tools, not squares, to say nothing of the many tumbles they get in their lifetime.

In order to construct a correct square we must have a standard by which we may know for a certainty when our square is truly square. Fig. 1 is a standard of this kind, which, with its mate or opposite, determines correctness. *A* is a base with a parallel across its center. At right angles to this parallel piece is a second parallel pivoted to *A* in the center and held at each end by binding screws to *A* when in exact position.

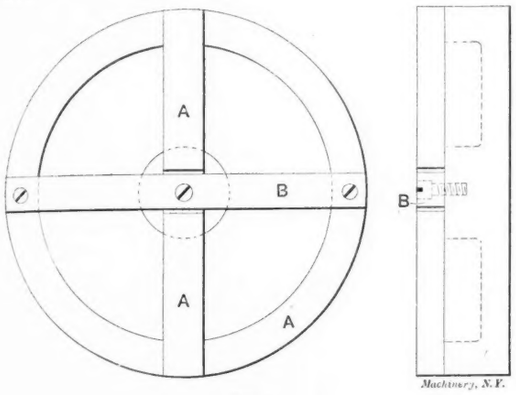
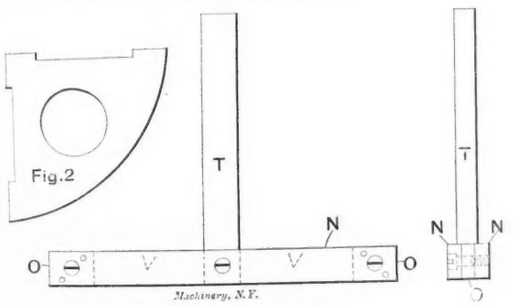


Fig. 1.

Special care must be taken that these parallel pieces are made true in every way. Now it is a self-evident fact that when *B* is at right angles with *A* we have a compound square, made up of four right angles. To construct a duplicate to fit we can follow out the removal of discrepancies by eight changes of positions if we use the template shown, Fig. 2; or if we make a template with four sides we can obtain thirty-two trial positions in the construction of an external and internal standard square. Having thus produced an exact square gage, both external and internal, we are provided with a standard of our own and we are not dependent on that "other fellow's" make for a test square.



Figs. 2 and 3.

Fig. 4 illustrates a convenient method of constructing a correct square. The base is *D*, and is a plane plate. On this is mounted the piece *C* which has been trued by square, Fig. 1. This fixture is for the purpose of locating the parts in correct position while being fastened together by taper pins. Now if we want a good job we must have a true taper reamer to ream holes to be fitted with good tool steel taper pins that fit the holes exactly. Press them in (don't drive with a hammer if you want a fine job) while the parts are held rigidly in place on the exact square block, and the result will be that the larger part of all squares thus put together will need no subsequent correction.

First produce good, true reams and blades, square and parallel, and then the matter of holding them together rigidly is an easy one if we do the job right, as shown. If we hold the beam and blade together by sweating or soldering we must have a fixture for holding the parts square all the same. If the blade and beam are held in place by taper pins as illustrated do not rivet over the ends to hold pins in. That will be wholly unnecessary if the pins fit well. When the square is together grind off the ends of pins neatly with sides of beam.

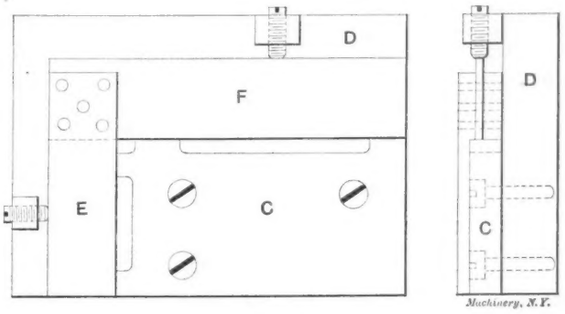


Fig. 4.

Fig. 3 shows one form of a master square by which all forms of squares may be tested, and in the test the constant correctness of it is manifest. The beam is made of the two pieces *N N*, with blocks *O O*, in each end. The whole is carefully finished parallel and square. The blade is also a carefully finished piece, and is mortised into the center of the beam. The openings *V V* serve to test any square, the inside with inside, or its outside, and by the numerous changes which can be made in trial an absolute perfect square can be produced.

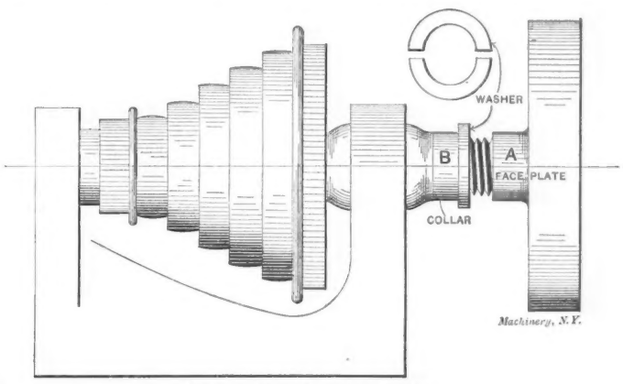
F. W. CLOUGH.

* * *

DEVICE FOR CUTTING MULTIPLE THREADS.

Editor MACHINERY:

Enclosed is a sketch of a lathe headstock illustrating a method for cutting multiple threads on one piece of work. The plan is to have a number of washers of varying thicknesses, according to the number of threads to be cut, these washers to be placed between the face plate *A* and the collar *B*. By turning the face plate solidly against the washer it will be advanced sufficiently to give the piece of work the necessary rotation (or part of a turn) to cause the tool to enter the work at the right points for each succeeding thread. The washers should be made in halves so they can be removed easily, and their thickness should be gaged very accurately. The face plate should also be a good fit on the spindle.



Multiple Thread-cutting Device.

Suppose there are six threads per inch on the spindle, and that a double thread is wanted. First make the cut with the face plate *A* tight to *B;* then for the next cut place a washer ½ × 1-6 = 1-12 of an inch thick between *A* and *B;* that is, the faceplate is loosened ½ a revolution. For a triple thread make the first cut with *A* tight to *B;* for the second cut loosen the faceplate 1-3 of a revolution and place a washer 1-3 × 1 6 = 1-18 of an inch thick. For the third cut, take out the 1-18" washer and loosen the faceplate and place a washer 2 × 1-18 = 1-9 of an inch thick. For a quadruple thread, make the cut with *A* tight to *B*, and for the second cut loosen the face-

plate ¼ of a turn and place a washer ¼ × 1-6 = 1-24 inch For the third cut take the 1-24 inch washer and place one 2 × 1-24 = 1-12 inch thick, and for the fourth cut take out the 1-12 inch washer and place one 3 × 1-24 = ⅛ inch thick.

This rule applies to any number of threads figuring from the number of threads per inch on the spindle. For example, I took six per inch. I hope this may be of value to some of your readers.

Auburn, N. Y. ARTHUR W. MCALPINE.

* * *

COMPOUND INDEXING.

Editor MACHINERY:

There have recently been several interesting articles upon compound indexing on the milling machine, and as among the many machines in the shop few have been more useful and universally adopted than the milling machine, most machinists are interested in anything pertaining to this class of work.

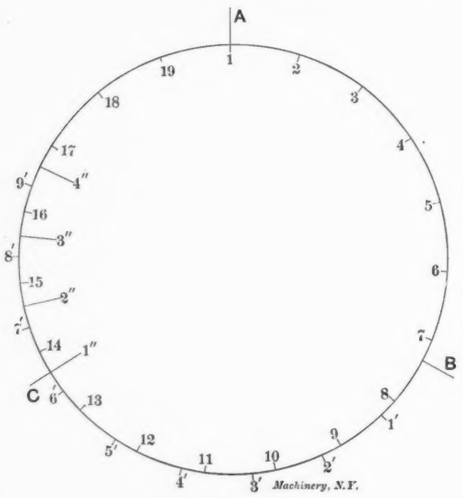


Diagram of Indexing.

Where no strict rule or table is laid down which will enable machinists to make a definite and positive choice, they will sometimes achieve the same results by adopting widely varying methods, and probably no machinists are confronted with such jobs oftener than the man in the job shop, and usually when he can least afford to waste time in trying experiments or looking for data. So a description of a job that was done in such a shop may prove of interest to some of the readers of MACHINERY, as it refers to compound indexing by a method I have not seen mentioned in any of the articles referred to above.

One afternoon the man in charge of the work on the milling machine received a gear blank to be cut with 57 teeth, and after setting the blank and the cutter he found that the number 57 was not given on the index table. After thinking about the problem for a few minutes, however, he hit upon a plan which can be explained by the aid of the accompanying sketch. The two factors of 57 are 3 and 19, and the process consists simply in a method for dividing the blank into 19 equidistant spaces and then dividing each of these spaces into three equal divisions. Referring to the illustration, let the circle be first spaced into 19 equal parts, as indicated by the numbers from 1 to 19, and then, starting at point 1 again, let it be divided into three equal parts, as shown at points *A*, *B*, and *C*. It will be seen that point *B* falls between points 7 and 8, one-third of the distance from 7 and two-thirds of the distance from 8, and point *C* also has the same relative position between points 14 and 13. Hence, we have made a beginning toward dividing the spaces between 7 and 8 and between 13 and 14 into the three divisions that they must have. Now, using *B* as a starting-point and spacing around into 19 divisions, giving points 1′, 2′, 3′, 4′, etc.; and finally, using *C* as a starting-point and spacing around again into 19 divisions, giving points 1″, 2″, 3″, 4″, etc., we shall have completed the divisions of all the original spaces into three parts, as indicated at the left of the sketch, and the whole circle will be divided into 57 parts.

The operations upon the machine were as follows, the three divisions *A*, *B*, and *C* being cut first. Taking the index plate with the 18 circle, and with the sector set 6 holes from the pin, the operator cut 3 spaces 13 6-18 turns of the crank apart. This divided the gear blank into the three equidistant spaces. Then, leaving the cutter in the last space cut, he stopped the machine, changed the crank pin to the 19 circle, and set the sector two holes from the pin, at the same time making a chalk mark opposite the three spaces already cut, so as to distinguish them from the spaces to be cut later. He then cut 19 spaces 2 2-19 turns of the crank apart, which divided the blank into 19 equal spaces. Next he stopped the machine again, loosened the dog, turned the blank until the second of the first three spaces was opposite the cutter, ran the cutter into it, tightened the dog, and cut 19 spaces as before. Finally, he shifted to the last of the first three spaces, and went around again, completing the blank.

I neither claim this method to be original nor better than others I have seen described, yet it is different. It is possible to divide many other numbers by a similar method, first reducing the number into two prime factors, thus: 51 equals 3 times 17; 69 equals 3 times 23; 77 equals 7 times 11; 87 equals 3 times 29; 93 equals 3 times 31; 99 equals 9 times 11; 109 equals 3 times 37; 123 equals 3 times 41; 129 equals 3 times 43; 141 equals 3 times 47; 147 equals 3 times 49, etc. To divide 147, for example, divide into 49 spaces, and then each of these spaces into three parts.

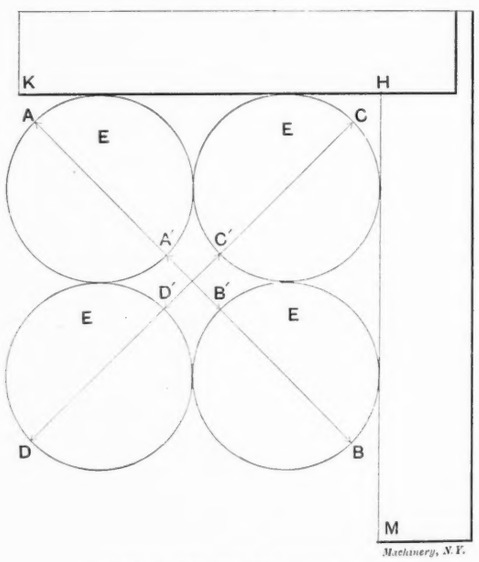
Providence, R. I. J. L. DINNANY.

* * *

METHOD OF TESTING AND ADJUSTING TRY-SQUARES.

Editor MACHINERY:

There are a number of geometrical methods for laying out right angles which give theoretically perfect results, but a geometrical method and a practical shop method for producing right angles are two vastly different affairs. Thus, for example, the geometrical conception of line is length without breadth, which is a condition in working mechanics impossible to realize except as the boundary of a solid.



Method of Testing Try-squares.

A solid or its equivalent which will have two boundaries at right angles for testing or adjusting try-squares, is ordinarily produced by a series of tests for inaccuracies with other gages or squares of more or less truth. This may or may not be satisfactory, the results depending entirely on the skill and patience of the workman.

The accompanying cut shows a method for testing and adjusting try-squares which requires nothing besides ordinary tools more than four disks of exactly the same size, but what size is immaterial only that the disks should, of course, be in proportion to the size of the square to be tested. To obtain four disks of the same size is not difficult, that is, within limits of—say one-ten-thousandth of an inch, which

is perhaps closer to absolute accuracy than the average try-square will ever be required.

Having four such disks, arrange them as shown in the cut to test a try-square, and then, with outside calipers, test the distances *A B* or *C D* (or with inside calipers test the distances *A' B'* or *C' D'*). If the two distances measure the same, the line *K H* and *H M* must form a right angle. Any deviation from a right angle will be multiplied by two making this test extremely accurate. Thus if the disks *E E* crossed by the line indicating the distance *A B* are closer together by one-thousandth of an inch than they should be for the right angle position, the other two disks will be pushed one-thousandth of an inch apart, making the difference in the measurements two thousandths. Since a workman skilled in the use of calipers can readily detect a difference of one four-thousandth, it is evident that this test would detect differences of one-half that, or one eight-thousandth of an inch. This test does not, of course, prove anything except the position of the points touched by the disks, but in practical try-square making the first thing to do is to get the blade and beam as nearly perfect straight edges as possible before fastening them together, and they should be so tested before applying one for the right angle position.

Newark, N. J. F. EMERSON.

* * *

AN ECCENTRIC TURRET TOOL.

Editor MACHINERY:

The tool illustrated in the two accompanying illustrations was used in the monitor for turning a valve seat in the work, *I*. The work itself was made of 11-16″ round brass, and, as will be seen, finished complete in one operation. After the hole *H* had been drilled all the way back and tapped it was ready to be seated by the tool shown in Fig. 1, which was constructed in the following manner:

The tool consisted of a bar or holder *A* of cast iron, which was centered and the shank turned to fit the turret hole in the

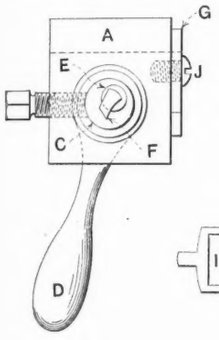


Fig. 1.

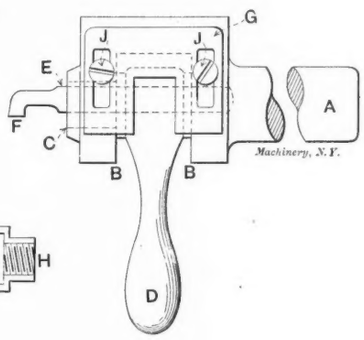


Fig. 2.

monitor. It was drilled and bored, leaving a ½″ hole thorugh the front at *C*, and then it was removed from the chuck and set up in the milling machine, where it was milled out to the size shown at *B B*.

Now came the working lever *D*, which was made of cast iron and through the body of which a hole 5-16″ in diameter was drilled and reamed, and, after being driven on a mandrel, it was turned and faced on both sides to fit between the sides of the body *A* at *B B*. An eccentric bushing *E* made of tool steel, was turned to fit the hole *C* and drilled and reamed 5-64″ eccentric, leaving a hole 5-16″ in diameter. This bushing was hardened and drawn to a dark blue temper, and a hole for the set-screw that holds the bushing in place was drilled and tapped, as shown. A piece of steel ⅛″ thick was made to the shape and size indicated at *G*, with a slot cut at each side for the screws *J J* and lengthened for adjustment. This piece was used as a stop and gage for the lever *D* and also to cut the seat *I* to its proper size.

The cutting tool was then made and finished to the size and shape above illustrated, and the bushing *E* was inserted within the hole C and turned until in the proper position, and then held tight by the setscrew. A 5-16″ hole was drilled in the body of *A* by using the bushing *E* as a jig. The lever *D* was inserted within *B B*; the cutting tool *F*, through the bushing *E*; and the hole in the lever and within the hole of the body *A*, as indicated by the dotted lines in Fig. 1. A set-screw in *D*, resting on a flat filed on the shank of *F*, held the cutting tool firm in the lever.

The tool, being now complete, was set up in the monitor, and the slide was moved until the tool *F* entered into the hole *H* of the work, Fig. 2. After the tool had gone in the proper distance, the stop screw of the slide was set, the lever *D* was raised slowly, and the tool began cutting away until the seat *I* was the proper size. The stop plate *G* was then set, and when the cut was finished the lever *D* was dropped to its former position, which allowed the tool to be withdrawn without touching the sides of the hole *H*. A pair of inside calipers was used for sizing up the holes.

The tool worked very quickly after the operator became used to it, and produced work of uniform size. Besides this, it was a cheap tool, when considering the results, which were as satisfactory as could be desired.

Brooklyn, N. Y. JOSEPH VINCENT.

* * *

JIG FOR DRILLING SMALL THREAD DIES.

Editor MACHINERY:

A short time ago I had a job of making 100 small thread dies for screw machine work. To have drilled them in the regular way would have taken a great deal of time and made them very expensive, so I made the jig shown in Fig. 2 for the purpose.

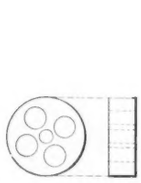


Fig. 1.

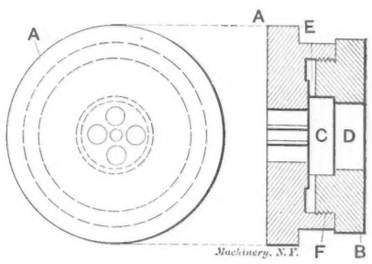


Fig. 2.

First, I turned and finished a bar of tool steel to exactly the right size for the dies and then cut off the blanks, being particular to get them all the same thickness and also to chamfer the corners. Fig. 1 shows the die blanks, which are ½″ in diameter. Fig. 2 shows two views of the jig, the top and a cross section. The jig was made in the shape of a round box. *B* is a piece of round machine steel turned and finished as shown with a thread of 10 pitch cut at *F*, which was cut loose in order to work the jig rapidly. At the same time the seat for the blanks was turned out at *C* so that the blanks would just fit in without plug. A hole was then bored through at *D* to give a clearance when the drill came through and also to let the chips out. The jig proper, *A*, was a piece of round tool steel chucked and finished all over in the way shown. The center hole was drilled at the same time, and a circle was struck to drill the other four holes by. The outside was heavily knurled to give the operator a good grip. All holes were reamed and slightly countersunk to allow the drills to enter freely, when it was carefully hardened and drawn, being then ready for work. The blanks were laid in at *C*, the cover *A* was screwed down, the holes all drilled, and another die inserted, and so on with them all. It was surprising how quickly the dies were made by the use of this jig.

Brooklyn, N. Y. WILLIAM DORAN.

* * *

Cryolite is a white translucent mineral formed of sodium, aluminum and fluorine chemically combined. It is found in Greenland in large masses, and was formerly the principal source of aluminum and also of almost chemically pure alum and sodium carbonate. Its most interesting feature, however, is that a beautiful opaque substance resembling porcelain, and as attractive as china, can be made by melting with it sand and zinc oxide. From the material so made, tableware such as plates, cups, saucers, etc., can be formed by stamping. Such ware is said to be so tough as to be practically unbreakable, even when thrown with violence against some solid substance.

NEW TOOLS OF THE MONTH.

Under this heading are listed the new machine and small tools that have been brought out during the preceding month. Manufacturers are requested to send brief descriptions of their new tools as they appear, for use in this column.

Schumacher & Boye, Cincinnati, O., have brought out a new line of turrets for the carriages and for the beds of their engine lathes. These can be used in the place of the ordinary tool post slide, or in place of the tailstock, adapting their ordinary engine lathe to a wide variety of work.

Baker Bros., Toledo, Ohio, are building a drilling, boring and tapping machine intended for steam and gas fittings from 2″ to 10″ in diameter. It is also adapted for drilling, counterboring and facing such work as heavy steel castings, drop forgings, and for boring engine and pump cylinders, steel gears, etc. A special chuck is provided for holding heavy pipe fittings.

A molding machine of unusual size is now manufactured by the Maywood Foundry & Machine Company, Maywood, Ill. One recently built for the Peru Steel Casting Company, Peru, Ind., produces molds for castings six feet long weighing about 300 pounds. The machine is operated by compressed air. Its operation has shown that it is possible to effect a substantial saving in molding large castings.

A horizontal boring, drilling and tapping machine has been brought out by the Hoefer Manufacturing Company, Freeport, Ill. A horizontal table slides upon ways on the bed of the machine and there is an upright carrying the head containing the boring bar and the driving and feed mechanism. The head has a vertical movement of 40″, and the table is 33″ square. The greatest height from the spindle to the table is 41½″; horizontal spindle 16″; diameter of spindle 1 11-16″.

Greaves, Klusman & Company, Cincinnati, Ohio, are manufacturing a new 22″ engine lathe of heavy design. The cone has five steps for a 3″ belt, the feeds are all reversed in the apron and there is an automatic stop. The friction cross feed is graduated in thousandths of an inch and in the compound rest both slides are fitted with taper gibs. There is a positive-geared feed and there are also four changes of belt feeds, and the change can be made from one to the other without disconnecting either.

The Curtis & Curtis Company, Bridgeport, Conn., have recently brought out a convenient machine for cutting and threading pipe. It consists of a Forbes die-stock mounted on a suitable stand and geared to an electric motor for power. The combination is well adapted to pipe work in unfinished buildings, in factories during a shut-down when the regular power is unavailable, and in many other places, as it is a strictly portable machine, which thus enables it to be taken to the work instead of hauling the pipe to a shop. The machine is furnished with electric motors of from one to fifteen horse power, and wound for a voltage of 115, 230 and 500 volts.

The Bullard Machine Tool Company, Bridgeport, Conn., have re designed their 37″ boring mill, making a machine with many improvements. The capacity of the mill has been increased so that it will take at least 40″ in diameter. The table is provided with chuck jaws, the whole making a combination chuck of the full diameter of the table, and if desired these jaws may be removed and independent jaws used instead. The arrangement of the feed has also been changed, so as to give a greater range, from 1-32″ to ¾″ horizontally, and 1-16″ to ½″ in angular and vertical directions. The method of changing the feeds is new and consists of an improved gear mechanism by which the feed can be changed when the machine is in operation. The table has ten changes of speed. A countershaft runs in brackets bolted to the top of the uprights on which one of the driving cones is placed, the other being at the base of the machine as usual. This makes the machine self-contained, and adapts it for operating with an independent motor when desired.

NEW 36-INCH SPRINGFIELD ENGINE LATHE.

The new 36-inch engine lathe recently brought out by the Springfield Machine Tool Company, Springfield, Ohio, is a machine designed to meet the requirements of modern machine tools, and is equipped with all conveniences necessary to properly perform the functions of a heavy engine lathe without being burdened with useless contrivances.

The headstock is made either with plain back gears or with triple gears, as desired by the purchaser. With plain back gears the ratio is 12 to 1, and with triple gears it is 51 to 1.

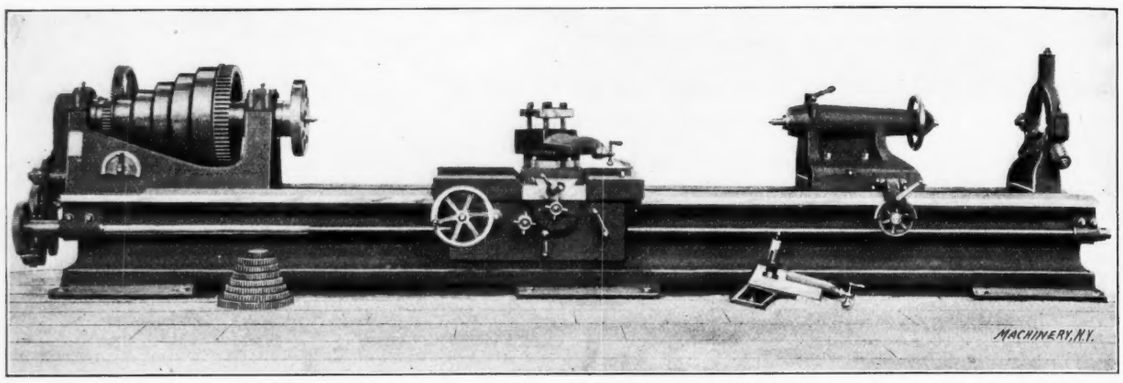


Fig. 1. Thirty-six inch Springfield Engine Lathe.

In either case the gears are arranged in geometrical progression, so that the variation of speed from one step to another is always in proportion to the variation between any other pair of steps, either in or out of gear. The spindle is of massive size, being 6 inches in diameter and 10 inches long in the front bearing, and 4⅞ inches in diameter and 7 inches long in the rear bearing. The hole through the spindle will readily take 3 inch rough iron bars, as it is 3 1-16 in diameter. The carriage has a long bearing on the ways, and is gibbed to the outside of the bed. The top slide of the compound rest, as well as the cross slide, has power feed. All feeds are controlled by friction clutches, and may be reversed in the apron. The tailstock is clamped to the bed by four bolts, and has a rack and gear attachment for readily moving it along the bed. The lead screw is splined for feeding, the thread only being used for screw cutting.

NEW MICROMETER CALIPER.

The micrometer caliper shown in Fig. 2 measures all sizes from 6″ to 12″ by thousandths of an inch. Six anvils, or measuring points, are furnished, each of which is designed for measurements varying by even inches, the fraction of the inch being determined by the micrometer screw, which has the usual range of one inch. A set of six standard end measuring rods is furnished for testing the accuracy of the measuring points. The interchangeable anvils *E* are held in place by the nut *G*. Each anvil is provided with an adjusting nut *F*, and a locknut *H*. To adjust for wear, loosen slightly the nut *H*, using a small wrench furnished with the gage, and back off nut *F* until, with the thimble set to zero, the required length is obtained; then re-

tighten the locknut *H*. The micrometer screw is made with the usual adjustments. This tool has recently been placed

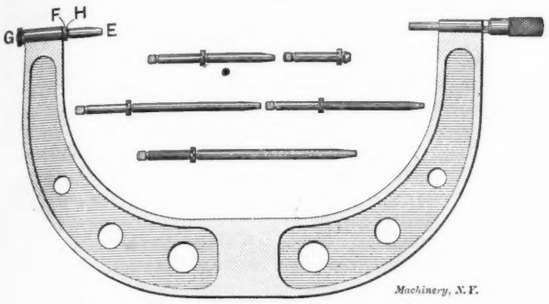


Fig. 2. Six to Twelve-inch Micrometer Caliper.

on the market by the Brown & Sharpe Mfg. Co., Providence, R. I. It is made in English or metric measurements.

NEWTON FROG AND SWITCH SLOTTER.

The illustration in Fig. 3 is of a new slotting machine, which is built upon different lines from the ordinary machine. This machine is especially designed for frog and switch work, and like all frog and switch tools it is built plain and excessively heavy, to stand the heavy cuts and rough handling. The machine has a stroke of 6½". This stroke, unlike the ordinary machine, is not adjustable, being driven with an eccentric with bronze connecting rod.

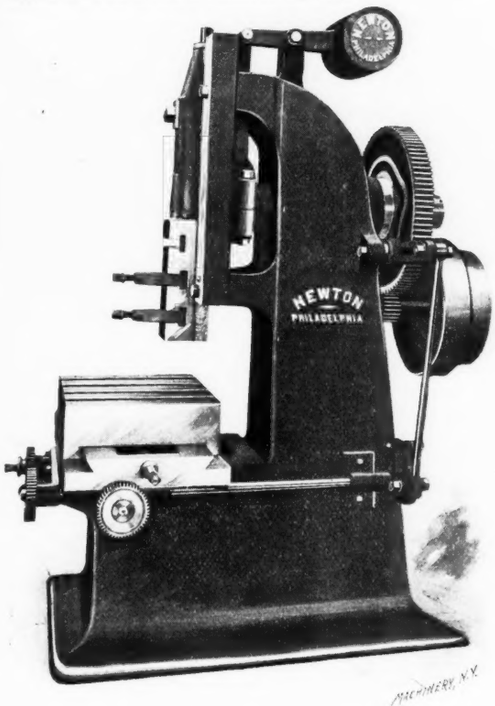


Fig. 3. Frog and Switch Slotter.

The machine is geared with the power of the average 14" or 16" slotting machine, and has an automatic feed longitudinally and transversely, no circular carriage being required. This short stroke slotting machine will weigh about 7,000 pounds. It is built by the Newton Machine Tool Works, Inc., Philadelphia, Pa.

TURRET CHUCKING LATHE.

The illustration, Fig. 4, is of a new 22" and 24" turret chucking lathe brought out by the William H. Eddy Company, 81 Exchange St., Worcester, Mass. The turret is carried on a cross slide which has a bearing on the broad longitudinal slide, thus adapting it to both chucking and facing without resorting to a special cross slide on the ways. It also makes the lathe adapted to facing heavier work than is possible where the facing must be done by a broad facing tool without the use of a cross slide. The specifications of the 26" lathe are 28" between centers; traverse of turret slide, with power feed, 18"; diameter of front bearing, 3 x 5"; hole through spindle, 1 7-16"; diameter of largest step of cone, 12"; width of belt, 4"; diameter holes in turret, 1¾". The machine is back-geared, has belt feed with a tightener for the belt, and the center rest is bored to receive bushings to support long cutter bars.

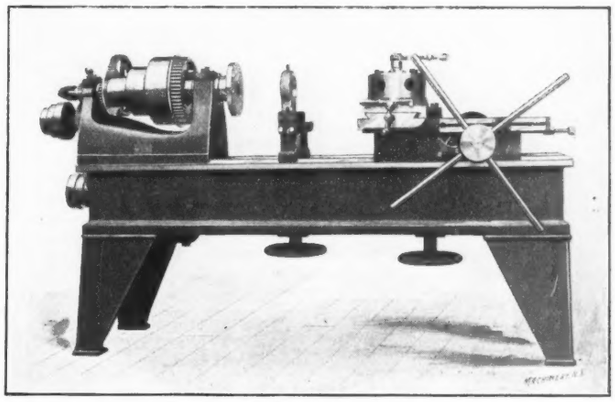


Fig. 4. Turret Chucking Lathe.

Lathes of similar design are built in sizes from 22" to 50" swing. Those of 26", 40" and 50" are made with the facing attachment.

KIRKPATRICK THREADING AND TURNING TOOLS.

Figs. 5 and 6 show a new threading tool and a diamond point turning tool for the lathe. The threading tool is so constructed that it is an offset tool without a bent holder, the point of the cutter thus being in line with the center of the holder in which position it is not deflected by side strains.

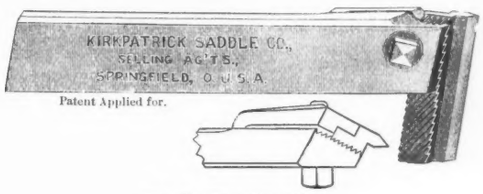


Fig. 5. Threading Tool.

The cutter is held by a strong side clamp but is relieved of any strain except that of holding the cutter in position. The cutter is diagonally serrated, which has the effect of holding the cutter more firmly in position with the pressure of the cut.

The diamond point turning tool is provided with cutters having serrated edges which prevent the cutters slipping with the heaviest cuts. The cutter is clamped on all four sides which gives it a solid bearing within the holder and

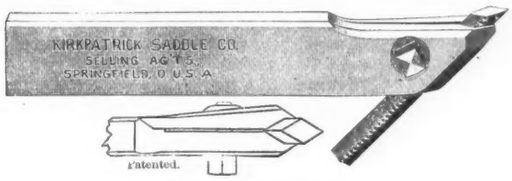


Fig. 6 Turning Tool.

tends to prevent all chatter. Cutters are furnished with either self-hardening or tempered tool steel. These tools are made by the Kirkpatrick Saddle Company, Springfield, Ohio.

SAWYER COMBINATION SQUARE.

The illustration, Fig. 7, shows the Sawyer combination square with hardened blade which is designed as a reliable and accurate tool to be sold at a low price. The curvilinear rib at the back of the head is about one-half inch wide and polished. Its shape is such that it conforms readily to the hand and thus makes the tool convenient to handle. The enameling being protected by the sides, the tool retains its rich appearance and is not likely to become marred by contact with other objects. The blade is one and one-half inches wide which makes the width such that the blade has no ten-

dency to sag in its length as is the case with a narrow blade. The blade is hardened and accurately ground so that its edges are true straight edges. The manufacturers, the Sawyer Tool Co., Fitchburg, Mass., inform us that a year or so ago

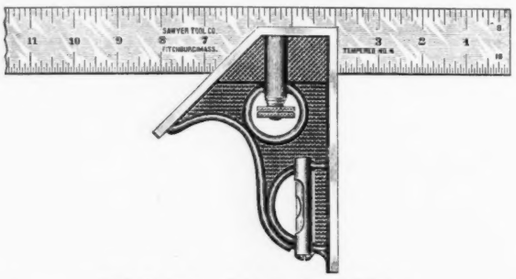


Fig. 7. Square with Hardened Blade.

they would not have believed it commercially possible to make accurate hardened scales as long as those furnished with these squares.

COMBINATION GRINDER.

This grinder is well calculated for the requirements of general machine shops, as it is readily adapted to a large variety of work. The spindle carries at one end a plain wheel for ordinary grinding, and at the other a cup-wheel, served by a vise, mounted on slides, having both transverse and longitudinal movement. Work held in the vise can be traversed across the face of the cup-wheel and faces finished at right angles to each other. The longitudinal slide move-

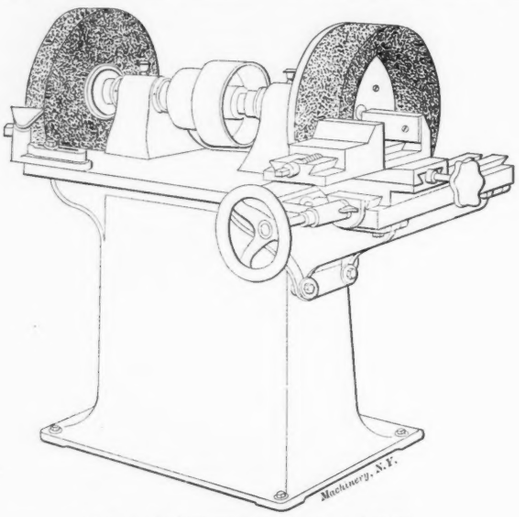


Fig. 8. Bridgeport Combination Grinder.

ment enables the depth of cuts to be adjusted to a nicety. The spindle has self-oiling bearings 7 inches long, with a diameter of 1⅞ inches in the bearings and 1½ inches in the grinding wheels. The vise has steel-faced jaws 6 inches long and 2¼ inches high, which open to take work 6 inches wide. The total weight of the machine is 875 pounds. It is manufactured by the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn.

THE HIGLEY COLD SAW SHARPENING MACHINE.

Where cold sawing machines are used it is essential that means be provided for keeping them sharp and true, so that all the teeth will do their full share of the work. On these conditions depends the efficiency of a cold sawing machine, as is quite evident. It is also quite essential that a machine for grinding such saws shall do it without drawing the temper, which condition necessitates a wet grinding machine if the work is to be done in the shortest possible time.

The accompanying cut shows an automatic cold saw sharpening machine which is believed to fulfill these requirements and which contains a number of new features. The grinding wheel runs in a water pan and is covered by a hood. When the hood is raised the water pan is lowered and the wheel runs dry. The grinding wheel is mounted on an adjustable sliding carriage, which has a short oscillating movement when grinding that carries the wheel to and from the saw. The saw does not require readjustment if it is necessary to grind around a second time. The saw is held over a drip table on an adjustable mandrel or stud, which takes all standard holes in saws up to the capacity of the machine. The indexing mechanism admits of grinding each tooth, each alternate tooth or every third tooth, as may be desired. The speed of the grinding wheel may be changed to suit the character of the abrasive without changing the rate of feed or indexing, since the wheel and feed mechanism are driven by inde-

Fig. 9. Higley Saw Grinder.

pendent belts, as is evident from the cut. The machines are adjusted for carborundum wheels, but, of course, other wheels may be used if desired.

The automatic machine is made in two sizes, Nos. 2 and 3. The No. 2 machine has a capacity for saws from 12½ to 26 inches in diameter and weighs 400 pounds. The No. 3 machine grinds saws from 12½ to 36 inches and weighs 550 pounds. They are sold by J. R. Vandyck, 136 Liberty St., New York.

A NEW CUTTING-OFF MACHINE.

To meet the demand for a machine to save time in cutting shafting and similar stock to lengths, Warner & Swasey, Cleveland, O., have brought out a special cutting-off machine.

The machine will be readily understood from the photograph. It is provided with an automatic chuck having capacity of round stock 2″ in diameter. It has a special double-tool cross-slide operated by power feed, a three-grade cone on spindle, a "stop" or "gage" for length of stock, double friction countershaft, etc.

The head of the machine is cast in one piece with the bed, making a rigid construction, and one which is adapted to heavy cuts and quick work. The cone takes a 4-inch belt, the largest diameter being 13″. One of the principal features is the automatic chuck shown in the cut, which is of a new type. Instead of having to stop the machine each time the stock can be gripped or released while the machine is in motion. The chuck is operated by the long lever shown in front of the head. The front end of the spindle is a forged head for holding the master collet, thereby bringing all the chuck mechanism close up to the bearing, but with a minimum of overhang. The master collet is made of carefully tempered steel, and in it are fastened the various bushings by suitable guides and a latch. One set of bushings is required for each size of stock. The bushings can be

changed with the fingers, without unscrewing the chuck ring or disturbing the chuck in any way.

An adjustable stop is provided for gaging the exact lengths of the stock, and it is so designed that after the work has been gripped, a movement of the lever relieves the end of the stop from contact with the stock and from consequent wear.

The cutting-off slide carries two tools, which are fed into the work simultaneously from opposite sides by means of right and left-hand screw and power feed. The feed is tripped automatically, and can be thrown in or out by suitable levers. The double friction counter-shaft provides

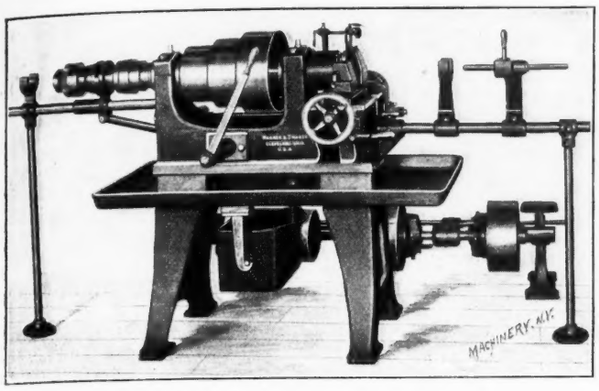


Fig. 10. Warner & Swasey Cutting-off Machine.

two speeds, so that the operator can avail himself of a slow and fast speed for each step of the cone. A copious bath of oil is kept upon both cutting tools by means of an improved pump, and suitable piping, thus making it possible to run the machine at a high rate of speed.

The worm and worm-gear, as well as other vital parts, are carefully protected from chips and dirt by metal guards. Suitable stock supports are provided for the work, both before and after it enters the automatic chuck, and the necessary wrenches, etc., accompany each machine.

* * *

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published

In reply to O. F.'s question, published in our December issue, as to how to produce the dull black appearance on wrought iron, a correspondent, Mr. Herman Sack, Campo Seco, Cal., says that he has used blackboard paint for this purpose, and has found it satisfactory.

29. O. D.: Kindly tell me how to braze cast iron? I have no difficulty in brazing wrought iron, machine steel or tool steel, but when I undertake to braze cast iron the spelter does not seem to take hold, but runs over the surface in the shape of little round pellets much the same as a drop of water on a hot stove.

A.—We will refer your question to our readers. The following hints on this subject may, however, be of value. It is a process for hard soldering cast iron, patented by Friedrich Pich, Berlin, Germany. The cast-iron surfaces are cleaned by means of an acid in the usual way, fixed together, and the soldering places covered or surrounded with a paste consisting of suboxid of copper and borax. The suboxid and borax are boiled together so intimately that the suboxid of copper is surrounded by a layer of borax-absorbing oxid, which excludes the action of the atmosphere upon the suboxid during the heating process required for soldering. For the borax other suitable fluxes, such as glass or water-glass, etc., may be substituted. While hard-soldering the cast iron and borax melts and protects, as is well known, the cleaned surface of the iron against oxidation, removes any oxid thereon, and also protects the suboxid of copper against the action of the oxygen in the atmosphere. Consequently the suboxid of copper, likewise heated to a red heat, transfers its oxygen to the red hot cast-iron surface, which oxygen combines with the graphite contained in the cast-iron surfaces to form carbon monoxid or dioxid, thus decarbonizing the surfaces; while the metallic copper becomes dissociated in a very finely-divided condition. At the same time the hard solder is added, and as this solder is likewise melted by the heat, it alloys itself with the incandescent particles of copper, and this new alloy immediately combines with the red hot decarbonizing soldering surfaces of the cast iron.

Answered by Wm. Baxter, Jr.

30. W. B. W.: We have in our power plant a brick chimney 100 feet high. Would it have been possible to have used two shorter ones? If so, by what formula would one work out the proper dimensions to secure the same draft?

A.—Two shorter chimneys could be used, provided they were not so short as to be incapable of developing the pressure required to produce the draft. To calculate the proportions of a chimney with any degree of accuracy requires skill and experience. The rules used for the purpose are of little service to the novice, as it is necessary to make several assumptions which cannot be made without a thorough knowledge of the subject. To draw the air through the grate, and the coal above it, as well as through the boiler flues, requires a certain amount of pressure. To draw the gases up the chimney an additional pressure is required. For this latter purpose, the amount of pressure will depend upon the size of the chimney; for the larger the area, the lower the velocity, and, hence, the lower the pressure. In any case, the height of the chimney must be sufficient to develop the required pressure. If the chimney is of small area, a large portion of the pressure will be required to draw the gases through it at a sufficiently high velocity to give the necessary supply of air to the furnace. In such a case, a considerable reduction can be made in the height by increasing the size of the chimney. To calculate the dimensions of a chimney it is necessary to determine the resistance offered by the grate, the coal and the boiler flues, and then the height is made sufficient to develop a pressure capable of overcoming this resistance. To determine this pressure it is necessary to know the temperature of the gases in the chimney, and to ascertain this by calculation is very difficult. The common practice is to assume that the resistance interposed by the grate, the fire and the boiler flues is a certain amount, and that the gases in the chimney have a certain temperature. When these assumptions are made, the calculation becomes quite simple. For a complete and short explanation of the subject see *Steam Engineering* for February, 1901.

* * *

A gasolene automobile recently caught fire in Philadelphia, according to the *Electrical Review*, and the driver lost his head and drove the machine at full speed through the streets in a mass of flames. At last, having become thoroughly disconcerted, he ran the machine into a lamp post on which was a fire alarm box. The driver was thrown 30 feet away and the lamp post and fire-alarm box were wrecked. This had an unusual result, as a moment later the fire engines and hook and ladder companies came tearing down the street looking for the fire, and they extinguished the flaming gasolene. A similar accident is said to have happened in a New England city, but the chauffeur in this instance had presence of mind and ran his automobile to a fire engine house. The firemen appreciated the convenience of having the fire brought to their door instead of being compelled to race to the fire and extinguished the flames with comfort and dispatch.

* * *

FRESH FROM THE PRESS.

Questions and Answers from the *American Machinist* compiled by Frank H. Richards. 403 duodecimo pages and 1088 questions and answers. Published by the American Machinist Press. Price $1.50.

As the title implies, the book is made up from the questions and answers that have appeared from time to time in the columns of the *American Machinist* during the past twenty odd years. About ten per cent of them have been selected and revised by Mr. Frank H. Richards, associate editor of that publication and divided into groups pertaining to such subjects as Steam Boilers, Steam Engines, Pumps and Hydraulics,

Compressed Air, Pneumatics, Electricity, Gas Engines, Marine, Power Transmission, Shop Practice, Screws and Screw Cutting, Gears and Gearing, Patternmaking and Woodworking, Foundry, Blacksmith, Drafting, Railroad and Locomotive, and so on including various recipes and formulas. Many of the answers have required a great deal of research and labor on the part of the editorial staff and others and deserve preservation. Their compilation in a convenient volume makes a most valuable contribution to technical literature.

Engineering Practice and Theory, by W. H. Wakeman. 184 pages and 28 illustrations. Published by the author at New Haven, Conn. Price, $1.

This is a new work by a well-known writer on engineering subjects, and is the sort of book that will be appreciated by the working engineer anxious to increase his practical knowledge of the steam engine and the kindred appliances of the power plant. It is intended as a help to the securing of engineers' licenses which are now required by a number of States and which will be required by many more in a few years. The book contains 200 practical examination questions which are answered in the text of the work, so that a careful reading of the same will enable the candidate to formulate the answers in his own language. An engineer capable of giving a correct answer to all of them would be likely to pass any reasonable examination for an ordinary position.

Electric Lighting, by Francis B. Crocker, E. M., Ph. D., professor of electrical engineering in Columbia University. Published by D. Van Nostrand Co., New York. 505 8-vo. pages, illustrated. Price $3.00.

This is the second volume on the subject of electric lighting by the same author. The first volume covered the apparatus of the power plant, while this volume supplements the first by taking up subjects connected with the distribution system, including the conductors for transmitting the current, the lamps and the various auxiliary devices. This volume is intended both as a text book for engineering schools and for practicing engineers, and for that reason abstruse and detailed matter has been omitted as far as possible. The treatment of the whole subject is complete and clearly presented, with many illustrations. It will prove valuable to any student interested in electric lighting who wishes to become familiar with the most practical aspects of the subject.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

Vitrified Wheel Co., Westfield, Mass. Illustrated catalogue of emery wheels, corundum wheels, grinding machines, emery wheel dressers, emery and corundum powders, etc.

J. S. Wheeler & Co., Worcester, Mass. Illustrated circulars of a 28″ x 28″ x 6′ planer, and of a 24″ x 24″ x 6′ planer. The circulars give specifications and full particulars.

The Star Corundum Wheel Co., Detroit, Mich. Illustrated catalogue of corundum wheels, and various types of grinding and polishing machinery, including automatic saw sharpeners.

E. W. Bliss Co., Brooklyn, N. Y. Catalogue of the "Stiles" power punching presses, which are made in numerous styles and sizes, some of them with automatic features, adapting them to a great variety of press work.

Armstrong Bros. Tool Co., 106-108 West Washington St., Chicago, Ill. Catalogue of machinists' tools and supplies made by different dealers, including the well-known line of Armstrong tool holders, boring tools, etc.

Joseph Dixon Crucible Co., Jersey City, N. J. Pamphlet giving information about Graphite as a lubricant. It will interest those who have occasion to use lubricants for any purpose, as it contains much information upon this subject.

Rochester Machine Tool Works, Rochester, N. Y. Illustrated circulars of the Buckley patent water-tube boiler, made in small sizes; the Acme stationary engine, in sizes of ½ to 7 H. P., and of the Acme automobile steam engine.

J. Wyke & Co., East Boston, Mass. Price and descriptive lists of machinists' tools. These include scales and combination rules, surface gages, key-seating gage, screw-cutting, center, depth, and angle gage, etc.

The Rogers & Hubbard Co., Middletown, Conn. A small pamphlet entitled, "How to Case-Harden, Color and Anneal with Granulated Raw Bone." This pamphlet gives concise yet complete directions, and will be sent to anybody upon request.

Massey Vise Co., 30-32 South Canal St., Chicago, Ill. Catalogue of bench vises of the usual type, and also the quick adjusting screw vise. The Massey planer and milling machine chuck, which tends to draw the work downward when clamped, is listed.

Becker Brainard Milling Machine Co., Hyde Park, Mass. Catalogue of the new 5B plain milling machine, with vertical attachments, described in the last number of MACHINERY. Also catalogue of the various sizes of the vertical milling machine made by this company.

Betts Machine Co., Wilmington, Del. Catalogue of boring and turning mills, ranging from the 5-foot mill to the largest sizes. The smaller mills are worm-driven, the worm-wheel being fastened directly to the table, which gives a constant and uniform driving pressure.

A third edition of the booklet, "Bulletin J," relating to "Mechanical Draft; What It Is and What It Does," has just been issued by the B. F. Sturtevant Co., Boston, Mass., from whom it can be obtained upon application. It illustrates applications under both the forced and induced methods.

Diamond Machine Co., Providence, R. I. Illustrated catalogue and price list of the large line of grinding and polishing machinery made by this company. The machines listed include not only the usual grinding and polishing machines, but automatic surface grinders and face grinders, spindle and roll grinders, knife grinders, etc.

Sebastian Lathe Co., Cincinnati, O. Catalogue of engine and speed lathes. Several sizes of foot-power lathes are made, and the belt-driven lathes are made in sizes of 13, 14, and 15-inch swing. Several speed and turret lathes are also illustrated, and a number of other machine and small tools sold by this company.

Warner & Swasey, Cleveland, O. Catalogue of the hollow hexagon turret lathe manufactured by this company. This machine has a capacity, through the automatic chuck, for rough iron bars up to 2″ in diameter, and turns work to a length of 24″. Automatic opening dies for threading are furnished for cutting threads up to 2″ in diameter, in connection with the triple-geared machine.

Jenkins Brothers, 70½ John St., New York. Catalogue for 1901 of Jenkins valves for all purposes. All steam and water valves made with either iron or steel or brass bodies and with the well-known Jenkins renewable disks which are composed of specially compounded materials to stand high-pressure steam, gases, oils, acids, etc. Other specialties, including the Jenkins '96 standard packing for all steam joints, are listed.

MANUFACTURERS' NOTES.

The Deep Leeds Transmission Co., of Australia, recently installed in their electrical power station a Cross oil filter, made by the Burt Mfg. Co., Akron, O.

The Acme Machine Screw Co., Hartford, Conn., announce that they have received official notice informing them that the John Scott Legacy premium and medal has been awarded them for their multiple spindle automatic screw machine.

The Star Brass Mfg. Co., Boston, Mass., have just made shipment to Clydebank, England, of a lot of safety valves and steam gages for one of the large ocean liners building there. The safety valves weighed 1,200 pounds each, the whole shipment comprising some 6 tons all told.

The Cling Surface Mfg. Co., Buffalo, N. Y., have written us of an instance where a belt treated with Cling-Surface has run with 31″ of slack, and yet carried more load than when it was tight. It is a surprise to one who has not seen the effect of this belt dressing to find how slack a belt will run after it has been applied and absorbed, leaving a surface as clean as patent leather.

The American Blower Company, of Detroit, Mich., expect to begin operations in the early spring upon extensive additions to their plant. The plans include a large addition to the steel plate fan erecting shop, which will be of steel construction throughout. A new blacksmith shop, storage warehouse and power house will be erected. The power house will be equipped with new apparatus, and the whole plant will be rearranged.

The Standard Pneumatic Tool Co., Chicago, Ill., manufacturers of the "Little Giant" air tools and appliances, have moved their New York offices from 619 Washington Life Building to more commodious quarters at 611-612-613 of the same building on account of the great increase in their business in Eastern and foreign territory during the past few months. All shipments for customers in the district just mentioned will be made from New York instead of Chicago, thus expediting delivery of machines.

Charles H. Besly & Co., 10 and 12 N. Canal St., Chicago, Ill., report business very good. They have added several new salesmen to their city department, and are prepared to handle this increased business promptly and carefully. In addition to their Perfection and Bonanza oil cups, they are introducing a new solid oil cup called the "Badger," which has an octagonal, cast-iron cap with round thread.

The new "General Circular" issued by the International Correspondence Schools, Scranton, Pa., is a 48-page pamphlet, describing briefly each of the courses of instruction offered by the schools. Portraits of the professors, views of the schools' handsome buildings, and other illustrations add interest to the circular, while the earnest letters from students who have secured better positions as a result of their studies testify to the successful methods employed by the schools in teaching by mail.